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ARCHIVES OF OPHTHALMOLOGY.

OCULAR ANAPHYLAXIS.

IV. THE ANTIGENIC PROPERTIES OF UVEAL TISSUE AS SHOWN BY COMPLEMENT FIXATION.

BY DR. ALAN C. WOODS, PHILADELPHIA.

(From the John Herr Musser Department of Research Medicine, University of Pennsylvania.)

IN the previous papers of this series (I., II., III.), we have outlined the anaphylactic theory of sympathetic ophthalmia, and have reported the results of perfusion experiments upon the sensitized eye. These experiments showed that the pigment of uveal tissue possessed the antigenic properties necessary to make the anaphylactic theory of sympathetic ophthalmia a scientific possibility. In its anaphylactic reactions, pigment acted as a foreign protein, an antigen, in animals of the same species; was organ specific and not species specific.

These same general conclusions had been arrived at by Elschnig (4, 5), whose method of study was the complement binding reaction of the sera of animals immunized to emulsion of whole uvea and to "chemically pure" pigment. Certain phases of Elschnig's work have been confirmed, but his fundamental observations have never been confirmed as a whole. Indeed, they have been criticized on what seems to be insufficient ground. In order to confirm our work upon perfusion, and to establish more clearly a scientific basis for the anaphylactic theory of sympathetic ophthalmia, it has seemed

worth while to repeat Elschnig's original work upon complement fixation.

HISTORICAL.

Elschnig's first step was to repeat the experiment of Roemer relative to the sensitization and immunization resulting from the intraocular injection of foreign protein. To do this Elschnig injected sheep's erythrocytes into the anterior chamber of the eyes of rabbits, and subsequently examined the blood serum of these rabbits for the presence of hæmolytic immune bodies, or amboceptor. He found that such intraocular injection led to a general reaction of the organism and caused the formation of hæmolysins.

Similarly, he injected cholera vibrio extracts and emulsions and determined the resulting agglutination reactions in the rabbits' blood, and so found that agglutinins, likewise, could be produced by intraocular injection.

Having determined this point, that the production of immune bodies followed intraocular injection, he turned to the anaphylactic theory of sympathetic ophthalmia, and sought to establish this theory by the determination of the following points. 1. Does uveal tissue, or a constituent thereof, possess antigenic properties? If so, does it possess these antigenic properties in the homologous animal (the property of acting as a foreign protein to an animal of the same species)? 2. If these points can be established, what are the properties of uveal tissue, or its specific constituent, as regards organ and species specificity? 3. What constituent of uveal tissue is responsible for these properties—cells, stroma, or the pigment?

The technic used by Elschnig was the determination by complement fixation of the immune bodies in the sera of animals immunized respectively to heterologous and homologous uveal emulsion. He found primarily that uveal emulsion had a somewhat toxic action in guinea-pigs and rabbits, many of these animals dying after injection from marasmus. However, rabbits were finally immunized to foreign and homologous uveæ and their sera obtained. These sera fixed complement with their respective antigens, estab-

lishing the fact that uveal tissue possesses antigenic properties, and can act as antigen in animals of the same species. A uvea immune serum, moreover, gave fixation of complement with antigens composed of uvea of any animal—the immune bodies were specific for the organ, or tissue, irrespective of species. This established organ specificity. It was found, however, that the sera of rabbits immunized to foreign uvea would fix complement with antigens of protein, other than uvea, from the species of animal to whose uvea they were immunized. Thus foreign uvea immune sera presented the anomaly of being both organ and species specific. Elschnig then showed that the sera of rabbits immunized to foreign (cow's) uvea contained a hæmolysin for cow erythrocytes. He accordingly believed that the species specificity of such uvea immune sera was due to such general protein as blood, smooth muscle, and connective tissue, as was contained in the emulsion of whole uvea.

The question was cleared up by immunizing rabbits to purified uveal pigment, and testing the complement fixation reactions of the resulting immune sera. It was found that these pigment immune sera gave fixation of complement with any uveal pigment antigen, regardless of species, and similarly with any uvea antigen. Thus they were organ specific. However, the pigment immune sera did not show hæmolysins for the erythrocytes, or give fixation of complement with general protein antigens from the species of animal to whose pigment they were immunized. Moreover, the sera of rabbits immunized to rabbit's uveal pigment showed specific antibodies for uveal pigment, and these antibodies were organ specific.

Elschnig therefore concluded that uveal tissue could act as antigen in the same species of animal, and that the pigment was the constituent of uvea responsible for this. In its immunological reactions, pigment was organ specific and not species specific, establishing a scientific basis for the anaphylactic theory of sympathetic ophthalmia.

As an incidental point Elschnig demonstrated that the fixation of complement, by uvea and pigment immune sera with uvea and pigment antigens, was due to the insoluble portions, pigment, in the antigen suspensions.

EXPERIMENTAL.

Elschnig's first point, the sensitization and immunization resulting from intraocular injection, has been confirmed by practically every worker on ocular anaphylaxis, and it does not seem necessary to repeat this experiment. His other experiments bearing directly upon the antigenic properties of uveal tissue, and uveal pigment, have been repeated and are here reported.

The chief pitfall in experimental complement fixation in dogs and rabbits is non-specific fixation. Kolmer and his coworkers (6) have recently made a careful study of this question. These workers have shown that normal sera of many rabbits and dogs will give fixation of complement with various antigens—non-specific fixation. They have further shown, however, that the sera of animals not giving non-specific fixation will continue negative unless actively immunized to the specific antigen. They have also shown that either using fresh unheated serum, or inactivating the serum at 62° instead of 56°, is an additional guard against non-specific fixation. As will be shown under technic, these several guards against non-specific fixation have been made use of.

In this work we have also endeavored to determine which antigen preparation will give the best results in the complement fixation reaction. If we are ultimately to determine in man the presence of uvea and pigment antibodies in existing and threatened sympathetic ophthalmia, as the researches of many foreign observers indicate is probable, it is of paramount importance that suitable antigens be determined. To this end we have prepared numerous antigens, both salt solution and alcoholic extracts and suspensions of whole uvea and pigment. The relative value of these antigens will be later indicated.

TECHNIC.

Preparation of Antigens. Antigens of cow's uvea and pigment and of dog's uvea and pigment have been used. The uveæ were removed from the eyes as already described.

Uveal antigens were prepared as follows: (1) Eight uveæ were macerated with glass in 40*cc* of salt solution, and the

mixture was allowed to autolyze at 37° for two hours, and at 0° for twenty-four hours. It was then strained through gauze, a heavy black filtrate resulting. (2) Eight uveæ were macerated with 40*cc* of absolute alcohol, and the mixture incubated at 37° for two hours, and at 0° for ninety-six hours. It was then filtered through filter paper, a clear yellow alcoholic extract resulting.

Pigment antigens were prepared as follows: (*A*). The pigment was prepared as recommended by von Szily.[1] This necessitates heating to 80°. (1) The pigment of eight uveæ was taken up in 40*cc* normal salt solution, and the resulting suspension shaken at high speed in a shaking machine for twenty-four hours. (2) The pigment of eight uveæ was taken up in 40*cc* absolute alcohol and shaken at high speed for twenty-four hours. (*B*). The pigment was prepared as previously described without heating.[1] Two suspensions, a salt solution and an alcoholic, were prepared as described under A.

Titration of Antigens. Various dilutions starting at 1:2 and running up to 1:16 were prepared of all these antigens. 0.5*cc* of each of these dilutions was now tested in the complement binding reaction with 0.5*cc* of 20 per cent. dilution of the sera of a number of dogs. The highest dilution giving inhibition of hæmolysis in this titration was taken as the anti-complementary dose. All antigens were used in three times this anti-complementary dilution.

Selection of Animals. After the anti-complementary dose of antigen had been determined, the sera of a number of normal dogs were taken. In this preliminary test the sera were inactivated at 56°, the optimum temperature of inactivation for the demonstration of non-specific fixation. The sera were diluted as described below, and every serum was tested against all antigens in the complement fixation reaction. Eight dogs, whose sera gave completely negative reactions in this preliminary test, were selected for immunization.

Method of Immunization. Preparations of cow and dog uveal emulsion and pigment were prepared as described in the previous papers. Immunizing injections were given intraperi-

[1] For details of the preparation of uveal pigment, consult paper III., of this series, ARCHIVES OF OPHTHALMOLOGY, No. 4, 1917.

toneally, and repeated every six days, until eight injections had been given. The initial injection was 5*cc*, the second 6*cc*, and so on, until 10*cc* were given at an injection. Two dogs were thus immunized to cow's uveal emulsion, two to cow's pigment, two to dog's uveal emulsion, and two to dog's pigment.

Preparation of Sera. Eight days after the last intraperitoneal injection, and at irregular intervals thereafter, these dogs were bled from the jugular vein, the serum removed from the clot, and inactivated at 62°, the temperature of inactivation which Kolmer has shown to be the least liable to give non-specific fixation. To remove any natural sheep erythrocyte hæmolysin, four parts of a 2.5 per cent. suspension of sheep corpuscles were added to the sera, and this incubated at 37° for two hours. The corpuscles were then thrown down by centrifuging, and the 20 per cent. dilution of serum pipetted off. This serum was now ready for use.

Complement Fixation Technic. To quantitate the strength of the reaction three different quantities of the dilute serum were used with every antigen, 0.2, 0.5, and 1.0*cc*. The serum, 0.5*cc* of titrated and properly diluted complement, 0.5*cc* of titrated and properly diluted antigen, and sufficient normal salt solution to bring the total volume in each tube to 2.0*cc* were mixed. These mixtures were incubated at 37° for one hour to allow for fixation of complement, and 1.0*cc* of a 2.5 per cent. suspension of sensitized sheep corpuscles were added to each tube. The tubes were now returned to the water-bath for three hours, and the results then read. The usual serum, hæmolytic, and antigen controls were made in every instance.

Reading of Results. Each tube was read separately. Complete or practically complete inhibition of hæmolysis was read as positive, fifty per cent. or more hæmolysis was read as negative. In the tables a +++ sign indicates that positive results were obtained with all three quantities of serum. A ++ sign indicates positive results in the tubes containing 0.5 and 1.0*cc* of serum, and a single + sign indicates that positive results were obtained only in the tube containing 1.0*cc* of serum. A negative result indicates that fifty per cent. hæmolysis, or over, occurred in all three test tubes.

RESULTS.

The results of this work are shown in tabular form. Table I. illustrates the complement fixation properties of the sera of animals immunized to foreign uvea and foreign pigment. Immunization with these led to the production of immune bodies, which fixed complement with the various uvea antigens. The antigens were not of equal value, however. The alcoholic extract of uvea appeared to be without antigenic properties, and after the first test had been made, and this fact demonstrated, this antigen was abandoned. The suspensions of pigment, prepared by the method of von Szily, were also irregular in their reactions, and did not give the degree of fixation shown by the suspensions of unheated pigment. In general the suspensions in alcohol gave weaker reactions than the suspensions in salt solution. On the whole, the two best antigens were the emulsion of uvea in salt solution, and the suspension of unheated pigment in salt solution.

After immunization had been completed, three separate tests of the complement binding properties of these sera were made. The first two tests were made with the original antigens used in the preliminary control test. These antigens had been kept in the ice chest at 0° during the period of immunization. The last test was made with freshly prepared antigens titrated and used in the same manner as the original antigens. The fresh antigens gave everywhere stronger reactions than the original antigens.

Table I. shows the complement binding reactions of immune sera against foreign uvea and pigment antigens. The results illustrated in this table demonstrate two points: (1) that uveal emulsion possesses the ordinary antigenic properties of protein, and (2) the uveal pigment possesses also the same common antigenic properties.

To make possible the anaphylactic theory of sympathetic ophthalmia, however, it must be demonstrated that uveal tissue possesses extraordinary antigenic properties. The first of these points is the ability of uveal tissue to act as antigen in animals of the same species. This is shown in Table II., which illustrates the complement fixation properties of the sera of dogs immunized to dog's uvea and to dog's pigment.

TABLE I.

HETEROLOGOUS (FOREIGN) UVEA AND PIGMENT IMMUNIZATION.

Sera.	Date.	*Antigen* Salt Solution Emulsion of Cow's Uvea.	*Antigen* Alcoholic Extract of Cow's Uvea.	*Antigen* Salt Solution Suspension of Cow's Heated Pigment.	*Antigen* Alcohol Suspension of Cow's Heated Pigment.	*Antigen* Salt Solution Suspension of Cow's Unheated Pigment.	*Antigen* Alcohol Suspension of Cow's Unheated Pigment.
Dog 16–89	Dec. 14	neg.	neg.	neg.	neg.	neg.	neg.
Immunized with Emulsion of Cow's Uvea.		Period of Immunization					
	Jan. 31	++	neg.	++	++	++	+
	Feb. 13	++	not done	+	+	+	neg
	Feb. 21 (Fresh antigens)	++	not done	++	++	+++	++
Dog 16–90	Dec. 14	neg.	neg.	neg.	neg.	neg.	neg.
Immunized with Emulsion of Cow's Uvea.		Period of Immunization					
	Jan. 31	+++	neg.	+	+	++	+
	Feb. 13	+++	not done	+	neg.	++	neg.
	Feb. 21 (Fresh antigens)	+++	not done	+	+	+++	+
Dog 16–91	Dec. 14	neg.	neg.	neg.	neg.	neg.	neg.
Immunized with Cow's Uveal Pigment.		Period of Immunization					
	Jan. 31	+++	neg.	++	++	+	+
	Feb. 13	++	not done	++	+	+	neg.
	Feb. 21 (Fresh antigens)	+++	not done	++	++	+++	++
Dog 16–92	Dec. 14	neg.	neg.	neg.	neg.	neg.	neg.
Immunized with Cow's Uveal Pigment.		Period of Immunization					
	Jan. 31	+++	++	+++	++	++	++
	Feb. 13	+++	not done	++	+	+++	+
	Feb. 21 (Fresh antigens)	+++	not done	neg.	+	+++	+

Here, also, three separate tests were made at varying intervals after the completion of immunization. The last test was made with fresh antigens.

This table illustrates not only the property of uveal tissue to act as antigen in the homologous animal, but shows also that the pigment is responsible for this property. This substantiates Elschnig's findings.

TABLE II.

HOMOLOGOUS UVEA AND PIGMENT IMMUNIZATION.

Sera.	Date.	*Antigen* Salt Solution Emulsion of Dog's Uvea.	*Antigen* Salt Solution Suspension of Dog's Pigment.
Dog 16–95	Dec. 14	neg.	neg.
Immunized with Emulsion of Dog's Uvea.	Period of Immunization		
	Jan. 31	+++	++
	Feb. 13	++	++
	Feb. 21 (Fresh antigens)	+++	++
Dog 16–96	Dec. 14	neg.	neg.
Immunized with Emulsion of Dog's Uvea.	Period of Immunization.		
	Jan. 31	++	+
	Feb. 13	+	neg.
	Feb. 21 (Fresh antigens)	+++	++
Dog 16–98	Dec. 14	neg.	neg.
Immunized with Dog's Pigment.	Period of Immunization.		
	Jan. 31	+	+
	Feb. 13	+	+
	Feb. 21 (Fresh antigens)	++	++
Dog 16–99	Dec. 14	neg.	neg.
Immunized with Dog's Pigment.	Period of Immunization.		
	Jan. 31	++	++
	Feb. 13	+	++
	Feb. 21 (Fresh antigens)	++	++

The next point to be taken up in the verification of Elschnig's work is the question of organ specificity. The relationship of both organ and species specificity to the anaphylactic theory has already been emphasized in the previous papers of this series. Table III. illustrates the organ specific

properties. The sera of animals immunized to uvea fix complement with any uvea antigen, regardless of species. Sera immunized to pigment likewise show this property, and it is doubtless to the pigment constituent that uveal tissue owes this antigenic property. This substantiates Elschnig's third point concerning the organ specificity of uveal tissue and uveal pigment.

TABLE III.

ORGAN SPECIFICITY.

Sera.	Date.	*Antigen* Salt Solution Emulsion of Dog's Uvea.	*Antigen* Salt Solution Suspension of Dog's Pigment.	*Antigen* Salt Solution Emulsion of Cow's Uvea.	*Antigen* Salt Solution Suspension of Cow's Pigment.
Dog 16–89 Immunized with Emulsion of Cow's Uvea.	Dec. 14 control	neg.	neg.		
	Jan. 31	++	+		
	Feb. 13	+	+		
	Feb. 21 (Fresh antigens)	++	++		
Dog 16–90 Immunized with Emulsion of Cow's Uvea.	Dec. 14 control	neg.	neg.		
	Jan. 31	++	+		
	Feb. 13	+	neg.		
	Feb. 21 (Fresh antigens)	++	+		
Dog 16–91 Immunized with Cow's Uveal Pigment.	Dec. 14 control	neg.	neg.		
	Jan. 31	++	+		
	Feb. 13	neg.	neg.		
	Feb. 21 (Fresh antigens)	++	++		
Dog 16–92 Immunized with Cow's Uveal Pigment.	Dec. 14 control	neg.	neg.		
	Jan. 31	++	++		
	Feb. 13	+	+		
	Feb. 21 (Fresh antigens)	+++	++		
Dog 16–95 Immunized with Emulsion of Dog's Uvea.	Dec. 14 control			neg.	neg.
	Jan. 21			+++	++
	Feb. 13			++	++
	Feb. 21 (Fresh antigens)			+++	+++

TABLE III.—*Continued*

Sera.	Date.	*Antigen* Salt Solution Emulsion of Dog's Uvea.	*Antigen* Salt Solution Suspension of Dog's Pigment.	*Antigen* Salt Solution Emulsion of Cow's Uvea.	*Antigen* Salt Solution Suspension of Cow's Pigment.
Dog 16–96 Immunized with Emulsion of Dog's Uvea.	Dec. 14 control			neg.	neg.
	Jan. 21			+++	++
	Feb. 13			++	+
	Feb. 21 (Fresh antigens)			+++	+++
Dog 16–98 Immunized with Dog's Uveal Pigment.	Dec. 14 control			neg.	neg.
	Jan. 21			+++	++
	Feb. 13			++	++
	Feb. 21 (Fresh antigens)			++	+++
Dog 16–99 Immunized with Dog's Uveal Pigment.	Dec. 14 control			neg.	neg.
	Jan. 31			+++	++
	Feb. 13			++	++
	Feb. 21 (Fresh antigens)			++	++

The question of species specificity is shown in Table IV. This question can, of course, be studied only in the sera of animals immunized to foreign uvea. It will be recalled that Elschnig stated whole uvea was species specific and pigment was not species specific. With us, the sera of animals immunized to whole uvea were species specific, as stated by Elschnig. A slight and variable fixation of complement with species specific antigens was, however, shown by the sera of animals immunized to uveal pigment. The difference between the strength of the reactions of the uvea-immune and the pigment-immune sera is marked however. Although from our work with complement fixation, we cannot definitely state that uveal pigment is non-species specific, we believe Elschnig's results to be correct. The dogs immunized to pigment, whose sera we used, were immunized to several different preparations, and it seems probable that in one, or possibly more, of these preparations, the pigment was not

washed free of all the other tissue of the uveal tract. The weak fixation of complement with species specific antigens shown by these sera is probably dependent upon a poorly developed immunity to this last factor.

TABLE IV.

SPECIES SPECIFICITY.

Sera.	Date.	*Antigen* Salt Solution Extract of Cow's Liver.	*Antigen* Salt Solution Extract of Cow's Kidney.
Dog 16–89 Immunized with Emulsion of Cow's Uvea.	Jan. 31	+++	+++
	Feb. 13	++	++
	Feb. 21	++	++
Dog 16–90 Immunized with Emulsion of Cow's Uvea.	Jan. 31	+++	+++
	Feb. 13	+++	+++
	Feb. 21	+++	+++
Dog 16–91 Immunized with Cow's Uveal Pigment.	Jan. 31	+	+
	Feb. 13	neg.	+
	Feb. 21	++	+
Dog 16–92 Immunized with Cow's Uveal Pigment.	Jan. 31	+	++
	Feb. 13	+	++
	Feb. 21	neg.	++

To conclude this phase of our work, it was determined whether the fixation of complement, shown by uvea- and pigment-immune sera with uvea and pigment antigens, was due to the suspension of tissue and pigment in the antigens, or to the extracts contained in the menstruum. To this end the antigens were centrifuged at high speed, and all solid constituents thrown down. The relatively clear menstruum was then pipetted off, and several of the sera tested against these extracts. The results of this are shown in Table V. Either negative or very weakly positive reactions were obtained here, and it seems certain that practically all the fixation of complement shown by immune sera with uvea and pigment antigens is due to the constituents, chiefly pigment, suspended in the antigens.

TABLE V.

COMPLEMENT FIXATION WITH EXTRACTS OF ANTIGENS—INSOLUBLE PORTIONS (PIGMENT) REMOVED.

Sera.	Date.	*Antigen* Salt Solution Extract of Cow's Uvea.	*Antigen* Salt Solution Extract of Cow's Pigment.	*Antigen* Alcoholic Extract of Cow's Heated Pigment.	*Antigen* Salt Solution Extract of Cow's Unheated Pigment.	*Antigen* Alcoholic Extract of Cow's Unheated Pigment.	*Antigen* Salt Solution Extract of Dog's Uvea.	*Antigen* Salt Solution Extract of Dog's Pigment.
Dog 16–90 Immunized with Emulsion Cow's Uvea.	Feb. 22	+	neg.	+	+	neg.	+	neg.
Dog 16–92 Immunized with Cow's Uveal Pigment.	Feb. 22	+	neg.	neg.	neg.	neg.	+	neg.
Dog 16–95 Immunized with Emulsion Dog's Uvea.	Feb. 22	++	+	+	neg.	neg.	neg.	neg.
Dog 16–96 Immunized with Emulsion Dog's Uvea.	Feb. 22	neg.	neg.	neg.	neg.	neg.	neg.	neg.

DISCUSSION.

The relationship of these findings to the anaphylactic theory of sympathetic ophthalmia has already been discussed. This work verifies the results obtained by Elschnig with the same method, and also verifies the results obtained in this laboratory with an entirely different and more fundamental method.

There is an additional point shown here which is probably of more clinical than scientific interest. This is the relative value of antigens. As has been stated before, several foreign observers have claimed that the sera of patients with sympathetic ophthalmia will give fixation of complement with uvea and pigment antigens. It is entirely problematical whether this will be found to be true. If existing or threatened sympathetic ophthalmia can be detected by this means it is of

immense interest and importance. From this work it seems that the best antigens for this purpose are the fresh salt solution suspension of cow's uveal emulsion and cow's unheated pigment, used in one third, or one half, the anti-complementary dose. If only one antigen is used, the emulsion of whole uvea is probably preferable, for it is much more easily prepared, and with fewer steps in its preparation anti-complementary action is more likely to be avoided. Cow's uvea is recommended for the reasons that since the reaction is due to the pigment and uveal pigment is organ specific and not species specific, it makes little difference from what animal the uvea is taken; fresh cow's eyes can be readily obtained, the uvea is more easily removed than in smaller eyes, and cow's uveæ are of sufficient size to be easily macerated. Moreover, in the very limited experience we have had with complement fixation in clinical cases, cow antigens have given the best results.

SUMMARY.

Dogs have been immunized to emulsions of foreign and homologous uvea, and to foreign and homologous uveal pigment. The complement fixation properties of these sera have been studied in order to verify the similar work of Elschnig, and more firmly establish the points assumed by the anaphylactic theory of sympathetic ophthalmia. Emulsions of whole uvea and uveal pigment possess ordinary antigenic properties. Moreover they are capable of acting as antigens in the homologous animal, and the pigment is the constituent of uveal tissue responsible for this property. In its immunological reactions, uveal pigment is organ specific and not species specific.

The best antigens for fixing complement with immune sera are fresh salt solution emulsions of whole uvea, and fresh salt solution suspensions of unheated pigment. The fixation properties of these antigens are due to the insoluble constituents suspended in the salt solution menstruum.

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A CASE OF ANEURYSM OF THE INTERNAL CAROTID ARTERY (INTRACRANIAL PORTION) AND ITS EFFECT UPON THE PATIENT'S VISION.[1]

By Dr. JOHN R. SHANNON, New York.

(With three figures in the text.)

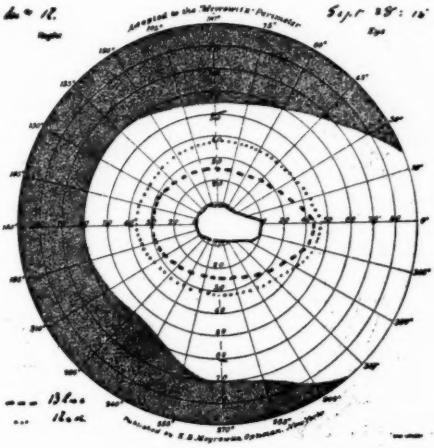
THE case which I wish to report is as follows:

I was consulted on September 28, 1915, by a lady, aged fifty-two years, the wife of a physician living in one of the suburbs of New York. She related that two days previously she noticed, on covering her left eye, that the vision of the right was blurred, and particularly with respect to colored objects. This condition persisted. I had seen the patient at intervals for some years, and had prescribed correcting glasses for a compound myopic astigmatism of low degree and for presbyopia. On the present occasion V. O. D. = counting fingers at three feet; O. S. = $\frac{20}{15}$, with correcting glass.

The condition of the affected eye as to pupillary reaction, transparency of the media, appearance of the eye-ground and optic-nerve head was normal, but on taking the visual field I found a small central scotoma of the dumb-bell variety, 10 degrees vertically, 20 temporally, and approximately 6 nasally from the fixation-point. The scotomata for colors were considerably larger, and in their customary order. Examination of the urine disclosed nothing of importance, and the blood, on examination, was found normal. The Wassermann test was negative, and this was subsequently verified from the spinal fluid. There were no signs of any toxæmia. The nasal sinuses were thoroughly examined by two most capable men and found normal, although, to "make assurance double sure," Dr. McKernon opened the right sphenoidal sinus shortly before Christmas. X-ray

[1] Read at meeting of the American Ophthalmological Society, 1917.

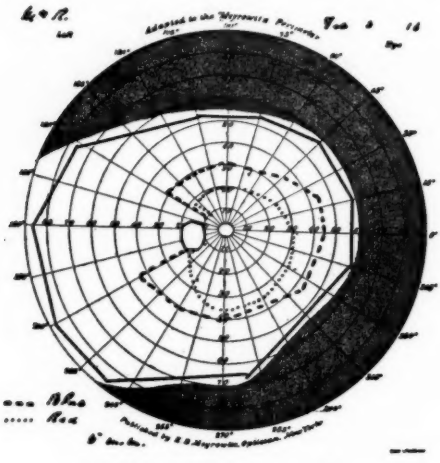
pictures of the skull and its contents were taken many times, but nothing was revealed; the teeth were carefully gone over by a competent authority, and two, which were slightly suspicious, removed. The patient was given pilocarpin injections, ¼ gr., every night for two weeks, but without effect, and potassium iodid and sodium salicylate were given to the limit of tolerance.



Field, September 28, 1915

In the meantime the condition of the eye grew worse; the blind areas in the field increased in size. By November 10th six weeks after the onset, the color fields had disappeared; pallor of the nerve head was not established until January 21st, although the vision had been lowered to a questionable detection of moving objects three weeks previously. During this period I had anxiously watched the condition of the left eye, and on December 3d noticed a possible slight wooliness of the disk margins; vision and field, however, were normal. A month later the caliber of some of the retinal arteries appeared a little irregular and the patient required a small increase in the myopic correction in order to read the normal line. On February 5th the vision was $\frac{20}{15}$ minus three letters. The field then showed an enlargement of the blind spot, with a sector-shaped defect in the temporal field for colors. A little later there appeared, in addition, a small central scotoma for small test-objects and the vision fell to $\frac{20}{30}$. I had the patient seen in consultation by Dr. Duane,

who concurred in the findings, but was unable to suggest a cause. On February 10th and the three succeeding days she was under observation by Dr. Harvey Cushing, who made an exhaustive study of the case, but confessed himself unable to offer any solution of the problem. I then had a thorough neurologic examination of the patient made by Dr. Foster Kennedy, being convinced that there must be some intracranial condition at the root of the trouble. Dr.

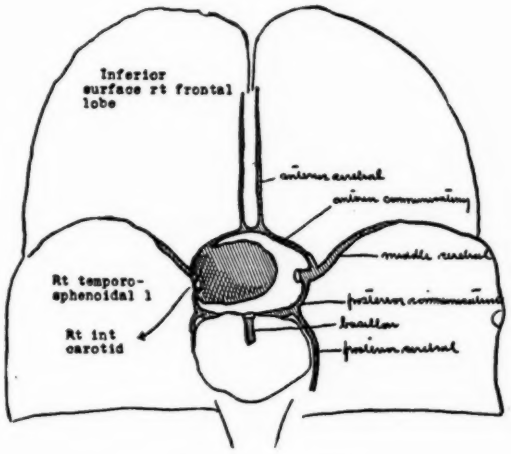


Field, February 5, 1916.

Kennedy reported to me his conclusions, which were briefly as follows: That there were symptoms, not very marked, but present, of a deterioration of function in the pyramidal tract going to the left side of the body. These, associated with the descending atrophy of the optic nerve on the right side, apparently progressing over to that of the left eye, and in spite of certain evidence opposed to the diagnosis, especially the presence, in an almost normal degree, of the sense of smell, led him to the conclusion that there was probably a slowly growing non-malignant tumor taking origin mainly at the base of the right frontal lobe. He, therefore, suggested a decompression operation in the right frontal region, saying: "I cannot but feel that, while the course that I think is probably wisest sounds rash and audacious, it is not more pessimistic than waiting until blindness has overcome the left eye as well as the right."

At this time the vision amounted to $\frac{20}{60}$, the field was as already described, and the fundus and media were practically normal.

On February 25th the patient was operated on by Dr. Charles Elsberg, who opened the cranial cavity and gently elevated the right frontal lobe, but no growth could be seen in the limited field thus disclosed. Further than this it was not deemed wise to proceed.



Showing Position of Aneurysm.

Recovery from the operation was steady but slow; there were some slight evanescent cerebral symptoms, but, on the whole, the patient was fairly comfortable. She was removed to her home on March 15th, and continued with little change in her condition, the vision a few days before her death being still $\frac{20}{60}$. On May 13th, shortly after rising, she complained of a sharp pain in the head, became immediately unconscious, and quickly lapsed into profound coma, dying ten hours afterward.

The autopsy disclosed an aneurysm of the right internal carotid artery, near the circle of Willis, which had burst, flooding the third, fourth, and lateral ventricles. The growth was so situated as to press upon the right optic nerve, which was atrophied, less markedly upon the chiasm and slightly upon the left optic nerve.

This case seems to me to be of special interest in view of the fact that the symptoms accompanying the progress of the malady were almost entirely ocular. The whole subject of aneurysm of the cerebral arteries was exhaustively studied by C. F. Beadles, who delivered a lecture on the subject before the Royal College of Surgeons of England in 1907, having collected 555 cases upon which to found his conclusions. According to this observer, definite symptoms occur in but 31 per cent. of the cases. In those affecting the intracranial portion of the internal carotid artery, while compression of one or both optic nerves or of the chiasm is not unusual, it is remarkable how seldom the sight is affected. The symptoms of brain tumor: headaches, vomiting, and choked disk, may be present, but it is also remarkable how frequently they are absent. Optic neuritis is rare; hemorrhages in the retina have been noted in a few instances. Focal symptoms are more frequent from aneurysm of the basilar, because the cranial nerves or the important paths which are close to the surface of the pons and medulla may be implicated. Among the case histories I find that one, published by Dr. S. Weir Mitchell in 1889, most nearly resembles the writer's case. In Dr. Mitchell's patient both internal carotids entered the aneurysmal sac and there were bitemporal hemianopsia, atrophy of both nerves and tracts, deep depression of the brain substance, and invasion of the sella turcica. The patient, however, suffered much from headache, often severe, great sense of fatigue, and weakness in the legs. Similarly, in a case reported by Bramwell, there were bitemporal hemianopsia, optic atrophy, and blindness; but there were also great general weakness and insanity preceding death. In my patient there were no such accompanying conditions; she went about her usual duties and occupations with a cheerfulness that was remarkable, being limited only, as far as I could see, by her defective eyesight, and the only headache that I remember her mentioning was consequent upon the opening of the sinus referred to above. There were at no time paralyses or cerebral symptoms of any moment. Beadles makes a careful study of the presence or absence of vascular murmurs in these cases, discusses the general question of diagnosis, and states: "There is not a single case on record of a murmur having been heard

in proved cases of aneurysm of the true intracranial portion of the internal carotid, or of any of the larger arteries of the base of the brain."

As to the diagnosis, the condition is entirely unsuspected before the fatal apoplexy in almost every case, being identified only upon the post-mortem table, and, as one writer puts it: "It is only in rare instances that a diagnosis of tumor can be made, and that such a tumor is an aneurysm is a deduction which is practically not justified."

SUPERNUMERARY ORBITAL MUSCLES.

By Dr. CALVIN C. RUSH and Dr. J. PARSONS SCHAEFFER, Philadelphia.

(From the Daniel Baugh Institute of Anatomy of the Jefferson Medical College, Philadelphia.)

(*With two illustrations in the text.*)

WHETHER or not the muscles of the orbit in man are derived from anterior head somites is a mooted point. Some assume that the first somite gives origin to the orbital muscles supplied by the oculomotor nerve, namely, the levator palpebræ superioris, the rectus superior, the rectus medialis, the rectus inferior, and the obliquus inferior; the second somite to the orbital muscle supplied by the trochlear nerve, namely, the obliquus superior; and the third somite to the orbital muscle supplied by the abducens nerve, namely, the rectus lateralis. However, positive and definite anterior head somites have not as yet been observed in man or mammals.

Reuter's observation in pig and Lewis's in human embryos show that the eye muscles arise from a common pre-muscle mass. Lewis recognized the pre-muscle mass in human embryos of 7*mm* in length as a lens-shaped mass of condensed mesenchyme lying dorsal to the optic stalk between the latter and the semilunar (Gasserian) ganglion and medial to the optic cup. At this time the oculomotor nerve enters the anterior end of the muscle mass. The trochlear and abducens nerves are not found at this early stage. In 9*mm* human embryos Lewis found the pre-muscle mass somewhat enlarged and beginning to show cleavage into separate muscle masses each supplied now by its usual nerve. In an 11*mm* embryo the pre-muscle mass was found further differentiated into the

several portions supplied by the aforementioned nerves. As cleavage and differentiation advance, the pre-muscle mass supplied by the oculomotor nerve gradually extends around the optic nerve and splits into the several muscles supplied by this nerve. One finds in 14*mm* human embryos all orbital muscles differentiated and having nearly the adult relations.

The pre-muscle mass supplied by the oculomotor nerve differentiates normally into a definite number of elements.

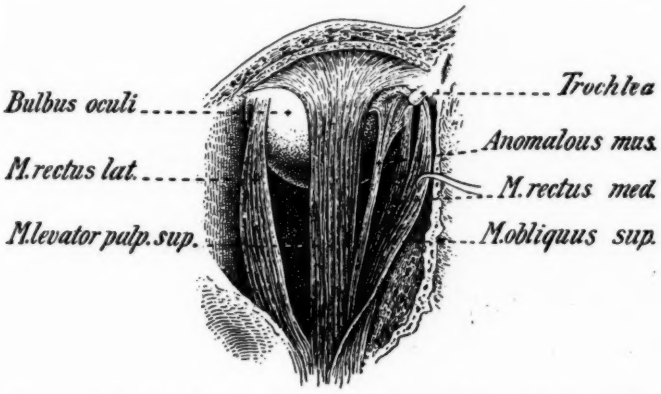


FIG. 1.—A drawing of an actual dissection of some of the extrinsic muscles of the eyeball, showing, in addition to the usual muscles, the origin, insertion, and relations of the supernumerary or anomalous muscle.

In some instances differentiation is carried further than usual and additional muscle slips appear. This must be the embryologic explanation for the muscle variant which serves as the subject of this note. It cannot be an aberrant portion of the orbicularis oculi muscle.

Few variations have been observed in the muscles of the orbit. Kelly found a levator palpebræ superioris attached in part to the frontal bone. Macalister noted the total absence of this muscle. The occurrence of supernumerary muscles in the orbit is sufficiently rare to make them interesting and worthy of note. Many of the supernumerary muscles have a common origin with the palpebræ superioris and are often referred to as the gracillimus or the transversus. Some

of these aberrant muscle slips do not partake of the nature of a transverse muscle and should not be so classed. Note, for example, the muscle which serves as the subject of this note.

Howe states that the first observer to describe such an orbital muscle was Albinus who found a muscular band "passing from the levator with connections inward, especially to the superior oblique." Later descriptions of this or similar muscles were made by Bochdalek and Budge. The muscle described by Bochdalek is more nearly transverse with additional attachments to the medial and lateral sides of the orbit.

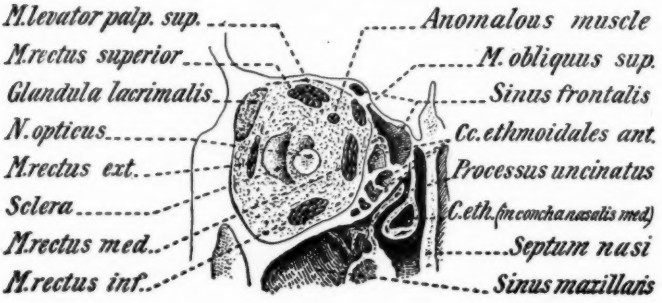


FIG. 2.—Frontal section of orbit and contained structures immediately dorsal to the eyeball, showing the supernumerary muscle in its exact relationships.

This transverse orbital muscle of Bochdalek is considered by Macalister a detached or aberrant part of the orbicularis oculi muscle. Galdani described a depressor palpebræ inferioris, attached to the tarsal plate, and in all probability this too is an aberrant part of the orbicularis oculi muscle.

Budge reports a muscle found in a certain number of subjects which is confluent with the medial border of the levator palpebræ superioris and is inserted into the trochlea of the superior oblique. This muscle has been named the M. tensor trochleæ or muscle of Budge.

In dissecting an adult orbit one of us (Rush) found a slender but well defined supernumerary muscle which was in some respects in agreement with the muscle described by Budge. However, the insertion of the muscle was more extensive.

It was a well-defined muscle of from 2 to 3*mm* in thickness which had a common origin with the levator palpebræ superioris along its medial border. At a distance of 12*mm* from their joint origin, it parted company from the levator and passing forward it assumed a position in the orbit almost equidistant from the obliquus superior, the rectus medialis, and the levator palpebræ superioris. At a distance of 30*mm* from its origin the muscle spread out into a peculiar fan-shaped attachment. The stronger central fibers of the fan extended forward in two or three strands to be attached to the upper and lower borders of the trochlea and even to the frontal bone beyond. A lateral expansion of the fan was directly continuous with a similar expansion from the levator and an inferior expansion was attached to the superior border of the rectus medialis. It received nerve filaments from the branch of the oculomotor nerve which supplied the levator.

Traction upon the muscle gave a feeble internal movement of the eyeball. The occasional presence of such a muscle in the orbit and its physiologic action should be kept in mind by the ophthalmologist.

REPORT OF A CASE OF TOTAL LOSS OF VISION IN ONE EYE AND PARTIAL LOSS IN THE OTHER COMPLETELY RELIEVED BY A SELLAR DECOMPRESSION OPERATION.[1]

By Dr. WALTER R. PARKER, Detroit, Michigan.

(*With three figures in the text.*)

J. H., male, aged thirty-three years, business manager, first came under observation October 20, 1915, complaining of loss of vision in right eye during past year, with rapid failure of vision during the past three months, until now the eye is nearly blind. The vision in the left eye began to fail during the past three weeks. The acuity of vision was variable. During this entire period of failing vision he has been subject to attacks of pain over right eye radiating to right mastoid region and occiput. It is made worse by stooping over, as in the act of tying his shoes, or by lying down. While the attacks are worse at night, they are not infrequent during the daytime. Recently, associated with pain he has extreme nausea and vomiting. He is readily fatigued.

Family History.—Father died of pulmonary tuberculosis. Mother died of cancer of the uterus at the age of fifty-six years. Paternal grandfather died of Bright's disease at fifty-eight.

Personal History.—When three years old, fell downstairs, striking his head on a crock, cutting left eyelid; at the age of ten he fell from a horse, was unconscious for some time, but made prompt and apparently complete recovery. History of chancroid ten years ago. Frequent infections of gonorrhea and venereal warts. Denies specific history. Says he has been unusually well all his life.

As a child was very thin, but later gradually increased in weight, until, when aged thirty, he weighed 180 pounds.

[1] Read at meeting of the American Ophthalmological Society, 1917.

During the past three years he has gained 20 pounds, without increase in size of hands or feet. Two years ago noted beginning anaphrodisia. Desires not lost, but diminished.

Eye Examination.—October 15, 1915, V. R. E. = $\frac{1}{200}$, eccentric; L. E. = $\frac{6}{7}$ — ½. Pupillary reflexes, right eye, sluggish to direct light, normal to consensual stimulation and in accommodation; left eye reacts normally to direct light, but sluggishly to consensual stimulation; accommodation reflex normal.

Ophthalmoscopic Examination.—Right eye: Media clear, disk slightly blurred nasally, with slight œdema. Outer

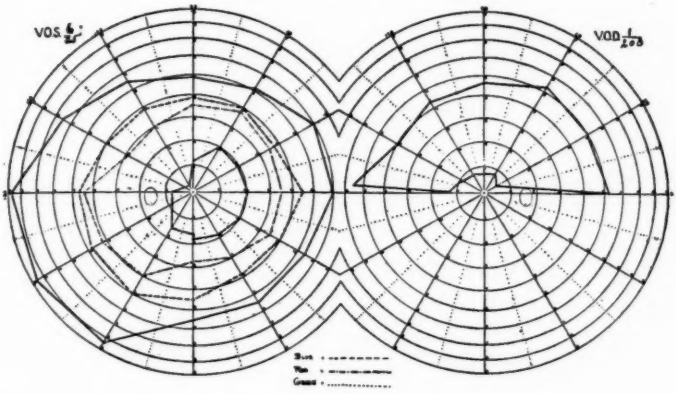


FIG. 1.—Visual fields before operation, October 4, 1915.

lower quadrant somewhat pale. Shallow physiologic cup present; lamina cribrosa not seen. Retinal vessels small, somewhat tortuous, slight arteriovenous compression. Foveal reflex present. Left eye: Media clear, disk not pale, rings present, but possibly slight œdema of nerve up and in; lamina cribrosa seen. Cilioretinal artery at 4 o'clock in place of inferior temporal. Slight engorgement of veins; no tortuosity of vessels, as noted in right eye.

Fields.—Visual fields, October 4, 1915—The right eye: No color perception. The form field was absent below; above, contracted to 55° out, 45° up, and 50° in. Left eye: The form field showed a temporal hemianopsia for green, otherwise normal (Fig. 1). Six days later the right field was entirely lost, except for a small temporal island. The left field showed quadrantal defects for green, red, and blue,

each varying in extent directly according to the size of the disk employed in taking the field. The fields for blue and red are shown in Fig. 2.

X-ray Examination.—Stereoscopic set of plates of the sellar region was made by Dr. Preston M. Hickey, who made the following report:

"The size of the sella is a little larger than normal, the increase being in the horizontal plane. The posterior clinoidal processes can be indistinctly made out. The absorption of the processes is most marked in the middle portion, so that the tips appear as isolated pieces of the bone. These

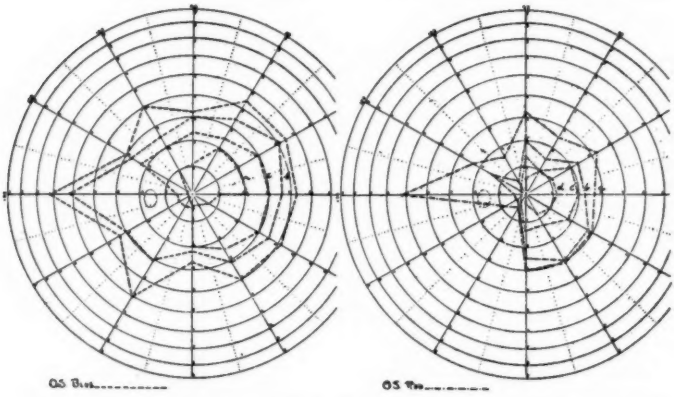


FIG. 2.—Fields for blue and red taken with different solid squares. Before operation: *a*, 10*mm* square; *b* 5*mm* square; *c* 3*mm* square; *d*, 1*mm* square.

findings would suggest a new-growth involving the soft tissues occupying the sella.

X-ray examination of the sinuses was negative except for a slight cloudiness of the left maxillary antrum.

Von Pirquet tuberculin test by Dr. Stafford strongly positive. Wassermann on blood and spinal fluid by Dr. Stafford negative. The spinal fluid was under considerable pressure and was clear and colorless. Examination showed marked increase of the reducing substance. Other laboratory tests negative. Severe headaches for several days following the spinal puncture—most severe when not in a prone position. This was followed, however, by a feeling of well-being and slight improvement in vision of left eye.

Physical Examination by Dr. Freund.—Patient normal

height. Appearance not feminine. Hair soft and thin. No change in quantity. Skin not altered in consistence. General adiposity but no marked distribution of panniculus in pads. Vascular tension, 120–75. Slight hypothermia. Other internal secretory glands not abnormal. High glucose tolerance: took 300*gm*; none appeared in urine. Teeth, fauces, heart, and lungs normal. No palpable abdominal organs. Prostate large.

On October 15, 1915, 0.45*gm* of neosalvarsan was administered as a provocative test. Wassermann reaction made in three separate laboratories was negative in each instance.

Diagnosis of tumor in region of pituitary body was made, and a sellar decompression operation advised. The patient refused to consider an operation of any kind.

In view of the seriousness of the visual changes and venereal history, the patient was empirically given active antisyphilitic treatment. Slight improvement followed the use of neosalvarsan and mercury, but it was of short duration. The patient finally consented to have the operation performed, and he was referred to Dr. Harvey Cushing October 28, 1915.

Sellar decompression operation was performed November 4, 1915, with removal of a portion of the pituitary struma. Five days after the operation the vision began to return. On the eleventh day the central vision in the right eye was normal and the field showed only an inferior nasal quadrantal defect. Dr. Walker reports as follows:

October 29, 1915: On admission his vision in the right eye was very slight light perception, which could questionably be determined to be in the upper temporal quadrant. In the left eye there was a characteristic temporal hemianopsia, almost complete for colors, with small disk 0.3.

November 11, 1915: Vision in the right eye $\frac{20}{50}$ +; slight indentation of the lower nasal quadrant, both for colors and form. The left eye, V. = $\frac{20}{15}$ —, with only slight defect detected on the green screen. Color vision, fields practically normal.

On December 12, 1915, the fields were normal except for an inferior nasal notching, and have remained the same.

Following the operation the patient was given 5 grains of the extract of the whole pituitary gland three times daily. This he has continued to take up to the present time. Except for an occasional attack of headache, he has been in good health, attending to his business without interruption.

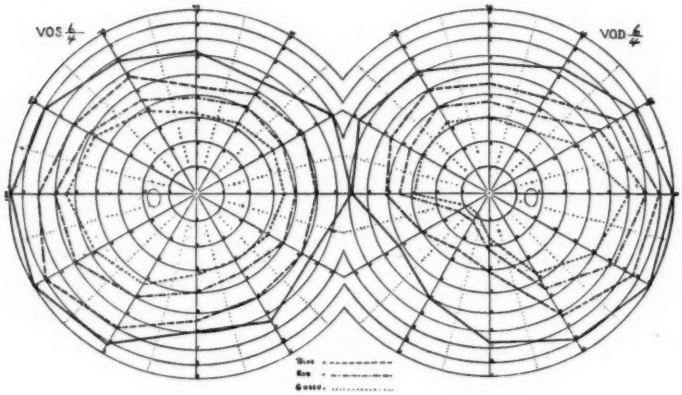
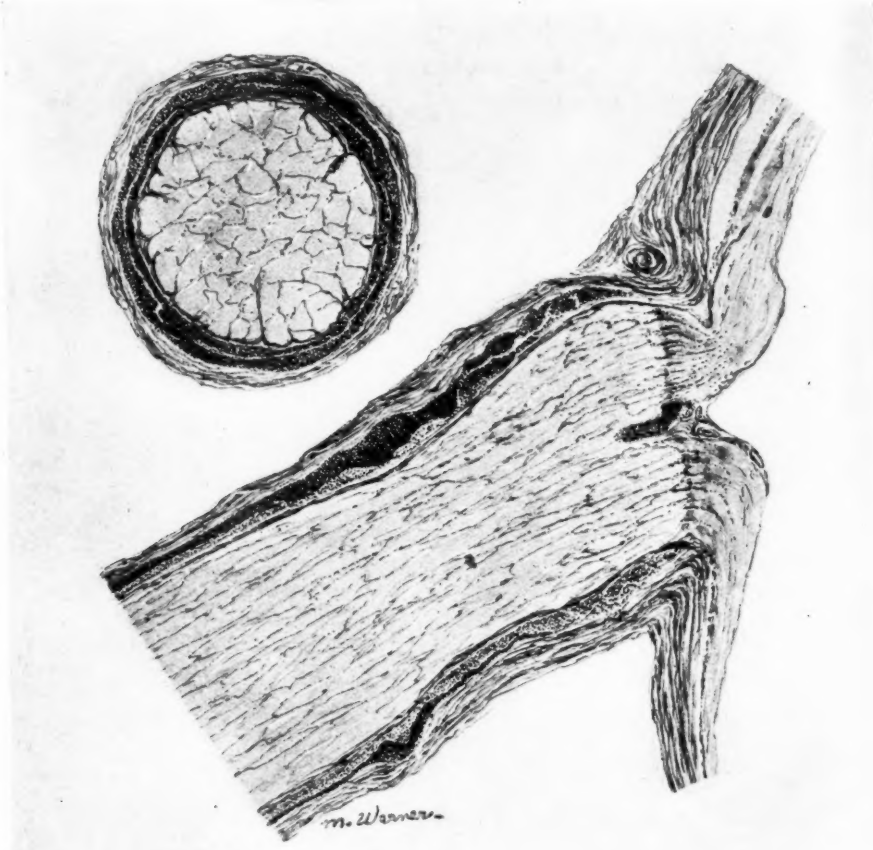


FIG. 3.—Fields, May 24, 1917. V. = R. E., $\frac{6}{4}$; L. E., $\frac{6}{4}$.

The case was apparently one of cyst of the pituitary gland with pressure on the chiasm leading to physiologic block, which was relieved by the sellar decompression.

The fields were taken by Dr. George M. Waldick, to whom I am indebted for valuable assistance in completing the records in this case.

ILLUSTRATING DR. DOUBLER'S AND DR. MARLOW'S ARTICLE ON "A CASE OF HEMORRHAGE INTO THE OPTIC-NERVE SHEATHS, ETC."



X10

A CASE OF HEMORRHAGE INTO THE OPTIC-NERVE SHEATHS AS A DIRECT EXTENSION FROM A DIFFUSE INTRA-MENINGEAL HEMORRHAGE CAUSED BY RUPTURE OF ANEURYSM OF A CEREBRAL ARTERY.

By Dr. F. H. DOUBLER and Dr. S. B. MARLOW, Boston.

(From the Medical and Pathological Services of the Peter Bent Brigham Hospital.)

(*With an illustration on Text-Plate XI.*)

THAT hemorrhage into the optic-nerve sheath, vitreous, and retina not infrequently follows fractures at the base of the skull is evident from the review of the literature by DeSchweinitz and Holloway in 1912, who also report the microscopic examination of a case. How frequently this condition occurs in cases of spontaneous intra-meningeal hemorrhage is uncertain. In a survey of such literature as was available, no case similar to the one reported here was found.

The patient, a negress, age given as about 32, was admitted to the Peter Bent Brigham Hospital on October 12, 1916, at 5 P.M. On account of her mental state a complete history could not be obtained. From her physician, who came to the hospital, it was learned that her family history was negative, that her previous health had always been good. She was married, but no details of her marital history were obtainable. A very questionable story of cocaine poisoning was given by the patient.

At 1 P.M. on the day of her entrance, she was suddenly seized, while at work, with vomiting, and fainted. The vomitus was in no way remarkable. The vomiting soon ceased. She seemed to regain consciousness but was unable

to talk. No convulsion, paralysis, or facial asymmetry was noted.

She was seen as soon as she came to the ward. Her pulse was 65, of good quality, respirations 30, rectal temperature 101.3°. Her heart was slightly enlarged and a few extra systoles were noted. Her neck was slightly stiff. Knee jerk was absent on the right side, and on the left barely obtainable. Achilles tendon and plantar reflexes were absent on both sides. The arm reflexes were not observable because the patient resisted manipulation and continuously made well co-ordinated but purposeless motions with her arms. There were no evidences of paralysis. The pupils reacted to light; eye movements were well performed. Kernig's sign was negative and no ankle clonus was made out. In other respects the examination was negative.

A lumbar puncture showed a bloody fluid under considerable pressure, 30*cc* being removed. The red cell count in this spinal fluid was 392,000 per cu. *mm*. There was slight temporary improvement after lumbar puncture.

About an hour after entrance a left divergent strabismus developed. The patient seemed to be failing rapidly.

At 7:30 P.M. a more systematic examination was made without modifying the results of the first examination. At this time her blood pressure was 180 systolic, 118 diastolic. A second blood-pressure reading was taken about an hour after the first. The diastolic pressure remained unchanged; the systolic pressure, however, could not be recorded on the machine, it being over 300.

At the first ophthalmoscopic examination of the right eye a large, red, apparently fresh hemorrhage was seen located on the disk, partly obscuring its upper half. There were a few smaller peripheral flame-shaped hemorrhages not impinging upon the disk or any blood-vessel. In the left eye the retinal veins were engorged. There were a few small hemorrhages scattered about. The picture was quite different from the right eye. Both fundi were examined from time to time. The large hemorrhage on the disk in the right eye grew in size until the disk was completely obscured. It partly filled the nasal side of the fundus and appeared to be extending into the vitreous. At one examination it seemed as though the hemorrhage could be seen to undergo enlargement. The hemorrhages in the left eye changed very little.

The patient died at 11:20 P.M., 6 hrs. and 20 minutes after her admission. Wassermann reactions on both blood and spinal fluid were negative. Her blood urea nitrogen was normal, Hgb. 105, white cell count, 25,000. Urine contained albumen, bacteria, a few red cells, no casts.

Autopsy was performed 10 hrs. *post mortem*. The following are the general findings. The heart was moderately hypertrophied, the myocardium containing many small patches of fibrosis. There were a few fibrous adhesions at the apex of each lung. Microscopically there were a few patches of early bronchopneumonia present. In the spleen hyaline obliteration of the arteries was present. The kidneys showed a slight degree of chronic nephritis.

The examination of the brain and eyes was the most interesting feature of the case. When the calvarium was removed the dura was noted to be distended and to have a deep purple color, particularly over the frontal lobe. On removal of the dura both hemispheres were found to be covered by a thin layer of blood clot from 3 to 5*mm* in thickness, which formed a perfect cast, particularly of the left hemisphere, where the bleeding had apparently been more extensive. On removal of the brain the largest amount of hemorrhage was found at the base. At the point where the internal carotid artery enters the cranial cavity there was an aneurysmal dilatation, measuring 1*cm* in diameter. Its wall was extremely thin, in some places like tissue paper. It had not been ruptured. Other areas of thinning were found in this artery and its branches, but the exact place from which the hemorrhage arose could not be found. (Presumably it resulted from the rupture of one of these areas of thinning.)

A coronal section at the tip of the temporal lobes showed how this hemorrhage had extended into the sulci and separated the convolutions. This was true particularly at the base, but it was also surprising how much blood forced its way into the sulci at the vertex. It is to be remembered that the systolic blood pressure rose rapidly to over 300. Possibly this high blood pressure may have been a factor in the wide-spread extravasation. There must have been some unusual force behind it for otherwise it is difficult to explain how it could have entered the optic-nerve sheaths.

Unfortunately it was not possible to remove the eyes intact. The posterior halves of each eye with both optic nerves were removed. As a result the retina became detached and wrinkled. A distinct ampulliform swelling of anterior portion of both nerves was noted. They were both quite firm. A cross-section, after fixation in formalin, showed the dural sheath to be distended by a ring of hemorrhage. This is shown well in the drawing, both nerves being similar.

Gross examination of the retina and papilla of the right eye showed a large, chocolate brown mass of clot completely overlying the papilla, extending in an irregular

manner into the vitreous. The macula was clear; the peripheral retina contained a few small hemorrhages. The retina of the left eye contained a small hemorrhage. The vessels in the papilla appeared congested.

In preparing the block of the right eye, the hemorrhage on papilla appeared to be a direct extension from nerve sheath. In the process of embedding in celloidin, the right eye was mislaid and could not again be found. Sections of the left eye were made.

Microscopically no hemorrhages were found in the retina of the left eye. The blood-vessels were congested, but there was no œdema evident. The hemorrhage in the sheath was present in both the subdural and subarachnoid spaces. It had extended as far anteriorly as the lamina cribrosa. At no place did it invade the nerve itself.

It is of interest further that an intracranial pressure great enough to force blood into the sheaths of the optic nerves and apparently through the lamina cribrosa should not produce a papillitis and choked disk. It is evidence that time is an important factor in the development of choked disk.

We owe many thanks to Dr. H. A. Christian and Dr. E. W. Goodpasture for permission to report the case. We are also indebted to Dr. F. H. Verhoeff who helped prepare the sections and gave us many valuable suggestions.

REFERENCE.

G. E. DeSchweinitz and T. B. Halloway. *Transactions American Ophthalmological Society*, vol. xiii., part i, 1912, p. 120.

QUANTITATIVE PERIMETRY: PRACTICAL DEVICES AND ERRORS.[1]

By Dr. CLIFFORD B. WALKER, Boston, Mass.

(With nine illustrations in text and three on Text-Plates XII., XIII., XIV.)

Introductory.

OUR problem has recently been to reduce the more or less cumbersome methods of quantitative perimetry to a systematic procedure of greater ease and rapidity. This is extremely desirable in a neurologic clinic, where many cases must be thoroughly and completely examined, although often in bad physical condition to withstand a prolonged session. Since a complete examination by the quantitative method usually means determining the peripheries for three to six different sizes of test-objects, in addition to the three color-fields, it is not surprising that we have found it necessary to study all possible short cuts to increase rapidity without decreasing accuracy.

First of all, the length of time the patient is able to maintain fixation and concentrate attention must be considered. We find that the patient's energy and attention will be most efficiently conserved if we arrange to take six or more consecutive readings during the attention period and record during the rest period, rather than to leave the patient at attention while single readings are being recorded. And we must see that the patient does rest during these periods, for many will remain at strained attention until told to relax.

[1] From the Peter Bent Brigham Hospital. The supplement to this paper may be found in the *Trans. Ophth. Sect. Amer. Med. Assoc.*, June, 1917, under the title of "Neurological Perimetry."

Read at meeting of American Ophthalmological Society, 1917.

On the other hand, many patients can give considerably more than six readings before becoming inaccurate, and with these cases we are limited in rapidity by our ability to memorize readings or to make rapid records. Indeed, it has been the memory system that has enabled us to keep the examination time within reason with the large number of cases that must be handled in a neurologic clinic. While this method may be cultivated by those who take field only occasionally, it will probably be found much more serviceable to those who have a considerable amount of perimetry to do.

To remember a considerable number of readings for a few minutes is not difficult if we reduce the distractions to memory to a minimum. These distractions may be discussed under several headings, thus: (1) mechanical; (2) regional disorientation; (3) uncertainty as to accuracy; (4) difficulty in reading and recording.

1. *Mechanical.*—The manipulation of the perimeter, screen, or test-object must become almost reflex acts, requiring practically no thought. The perimeter should be supplied with a ratchet automatically to fix its position at the various 30-degree intervals, so that the chart or scale does not have to be consulted for the exact position. One should then know, almost without thought, on what meridian he is working. The motion of the test-object and its position should be so reflexly sensed at all times that the examiner may watch the patient's eye and obtain the reading with the merest glance. Other details, such as keeping the patient's head in good position and holding his attention, will, in most cases, cease to be distraction if the patient is made comfortable and the room is quiet.

A tall black writing stand on 3-inch casters with chart clipped in position on the suitably sized top is a great time-saver. Such a table is shown in Fig. 8. This table also has convenient compartments in the top for disks and charts, and can be quickly pushed to a suitable position, so that many trips about the room, particularly in screen and umbrella work, are unnecessary. One simply records the fields in pencil with the free hand at suitable time intervals, later to be traced in ink. I prefer this method of making records

to that of sticking pins in the screen, for the reason that the attention of the patient is distracted by following the placing of the pins and sometimes becomes so interested in the growth of the field on the screen that accuracy is affected. Furthermore, it takes as long to stick a pin in and get the patient to refix on the center as it does to take another reading, so that is really time wasted. With our screens it is no more necessary than would be the same use of pins on the perimeter. Other mechanical advantages of the screens will be mentioned later.

VISUAL ANGLES

Disc Diam.	At 250 mm on Perimeter	At 500 mm on Umbrella	At 1000 mm on Umbrella	At 1500 mm on Combination	At 2000 mm on Combination	At 2500 mm on Combination	At 2750 mm on Screen	At 3000 mm on Screen	Disc Diam.
40.0 mm	450.0′ 65°-90°	270.4′ 65°-90°	137.6′ 65°-90°	91.9′ 65°-90°	68.8′ 65°-90°	55.0′ 65°-90°	50.0′ 62°-90°	46.8′ 65°-90°	40.0 mm
20.0 mm	240.0′ 65°-90°	127.6′ 65°-90°	68.8′ 65°-90°	46.8′ 65°-90°	34.4′ 65°-90°	27.5′ 65°-90°	25.0′ 64°-90°	22.9′ 62°-90°	20.0 mm
10.0 mm	120.0′ 65°-90°	68.8′ 65°-90°	34.4′ 64°-90°	22.9′ 62°-90°	17.2′ 61°-90°	13.7′ 59°-89°	12.5′ 59°-89°	11.45′ 59°-89°	10.0 mm
5.0 mm	60.0′ 65°-90°	34.4′ 62°-90°	17.2′ 61°-90°	11.4′ 59°-84°	8.6′ 59°-79°	6.8′ 44°-66°	6.25′ 47°-63°	5.7′ 48°-66°	5.0 mm
2.5 mm	30.0′ 65°-90°	17.2′ 61°-90°	8.6′ 56°-79°	5.7′ 43°-66°	4.35′ 39°-60°	3.4′ 35°-49°	3.12′ 33°-49°	2.8′ 31°-39°	2.5 mm.
1.25 mm	15.0′ 66°-90°	8.6′ 65°-76°	4.3′ 34°-51°	2.8′ 31°-39°	2.1′ 26°-36°	1.7′ 17°	1.56′ 16°	1.4′ 8°	1.25mm
0.62 mm	7.5′ 62°-71°	4.2′ 39°-50°	2.1′ 22°-30°	1.4′ 7°	1.03′ 2°	0.8′	0.78′	0.7′	0.62mm
0.31 mm	3.7′ 36°-45°	2.1′ 23°-30°	1.03′ 12°	0.7′	0.5′	0.4′	0.39′	0.35′	0.31mm
0.15mm	1.8′ 20°	1.03′ 12°	0.58′	0.35′	0.25′	0.2′	0.19′	0.17′	0.15mm

FIG. 1.—Table showing the visual angle in minutes and the corresponding normal field extent at the various distances. The values below the lower heavy line are too small for practical purposes, while those above the upper heavy line may often be used in damaged or contracted fields.

2. *Regional Disorientation or Lack of Visualization.*—If other distractions prevent one from keeping clearly in mind the orientation of the perimeter reading with reference to the patient's right or left field, and the corresponding right or left chart, a mental hesitation and retracing of steps will take place, combating the memory process. This difficulty may be soon eliminated by a little study and thought to cultivate visualization of the field with respect to the chart, the patient's eye, and the perimeter. A routine procedure greatly aids orientation. Thus we always begin with the right eye, and first examine from periphery along the right horizontal axis, at the same time mapping out the blind spot as an index of the patient's observation powers, and possibly at the same time detecting an enlargement or a paracentral

scotoma. From this the examination proceeds in clockwise direction about the field. The examiner stands, for the most part, on the patient's left while using the perimeter, or on either side while using the screen or umbrella, remembering that it is easier to maintain visualization if one stays on the same side of the patient throughout the examination.

3. *Uncertainty as to Probable Accuracy* of a reading may be the cause of much delay and consequent memory distraction. While good judgment of accuracy is obtained only by experience, the observer may use considerable data as an aid, in addition to the outlining of the blind spot already mentioned. A most useful thing is to have well in mind the normal reading in all parts of the field for either eye for all the commonly used disks and distances. This may seem to be a considerable amount of information for one to carry who does not do much perimetry. In that case a table, such as shown in Fig. 2, will show the two characteristic readings, which will recall to mind, by relation, the rest of the reading fairly well, or a normal field, such as is shown in Fig. 3, may be kept at hand. This holds for colored disks as well as for form disks, but since we are forced to save time it must be remembered, as we have stated elsewhere, that color defects are practically always represented by form defects when the visual angle is made small enough. Colors of visual angles less than 15 minutes (about 1*mm* on perimeter) are not satisfactory because of rapid fading and soiling, because of uncertain threshold of appearance at the periphery, and because of the ever-present excess of difficulty in qualitative distinction of colors as compared with simple detection of form or movement. While it is routine to take a full set of color-fields with 5*mm* or 2.5*mm* disks on the perimeter, the value of such examination we consider to be less than the quantitative examination with white disks of visual angles ranging from 15 minutes down to 1.4 minutes. Consequently, if circumstances demanded sacrifice of one examination or the other, the color tests would be waived, and this is especially true since we have given up color-interlacing as an important finding.[1]

[1] Walker, "Color Interlacing and Perimetry," *Trans. Amer. Ophth. Soc.*, 1916, xiv., 684.

As a further aid to judgment of accuracy, we are careful to keep in mind data accumulated from visualization of the "growing" field. That is, a great deal of exterpolation is possible in estimation of field peripheries, as well as with physiologic curves in general. It has been our experience that peripheral defects occur rather as a sagging inward than as a saw-tooth defect, except, of course, along the vertical meridian, where one looks for a relatively sharp defect.

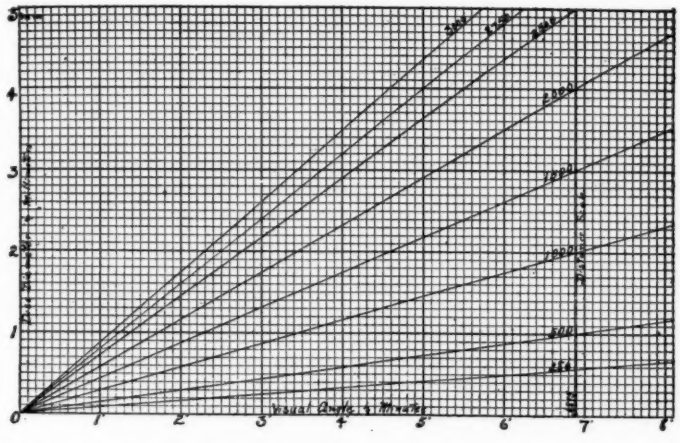


FIG. 2.—Plot for the rapid determination of the visual angles of the usual disks at the commonly used distances.

However, gentle curves are the rule, so that it pays to visualize the data as obtained. Jagged peripheries are more often obtained by mechanical perimeters and other thought-saving processes wherein readings are not so easily repeated and averaged.

A relative check of the accuracy of readings with a certain size of disk may be obtained from the readings of another size of disk. This results from the variation of field size with the visual angle of the test-object. This variation, represented by the plot (Fig. 3) for the normal field, also holds for defective fields to a certain extent, as we have described as "response to different-sized disks" in the previ-

ously mentioned paper. Thus, the reading of one size of disk may corroborate or cast suspicion on the reading of another disk, demanding, in the latter case, a repetition of the questionable readings.

In conservation of time and accuracy we must rapidly judge and pass over normal regions in order to devote all the time possible to the defective regions, where we may wish to take repeated readings every few degrees. In portions of the field which show normal readings it is not profitable to make records at less than 30-degree intervals, although we may actually take more readings.

It is evident that this procedure involves a judgment of the value of readings with respect to normality. Here we must distinguish between the normal outlines for normal individuals and the relatively normal portions of the field in the subnormal or neurological patient. Thus we may find in a patient that the outline to a certain disk is 10 degrees to 20 degrees less than normal throughout. A certain amount of general contraction may not tell us much because we see great variations of this sort, often without useful significance, but if, for instance, in two homonymous quadrants there is an additional contraction of 10 degrees to 20 degrees, then we have a valuable finding. Therefore, it is obvious that variations in the absolute size of fields are of far less importance than relatively excessive variations (defects) in certain portions thereof. That is, shape is more important than size from a diagnostic standpoint.

These considerations are woven into the procedure in this way. When it is found that the first reading is less than the standard normal for that particular visual angle, other readings are rapidly taken working toward the vertical meridian. If the readings differ uniformly from the standard and cross the vertical meridian with the same discrepancy, then these readings are accepted tentatively as the patient's normal for that disk, and are remembered by their difference from the standard normal and the search for a defect proceeds. If, however, on or before crossing the vertical meridian, the readings increase, we proceed still further, aiming to establish the patient's normal and return to the defect. On the other hand, if we find a still greater defect in the same way,

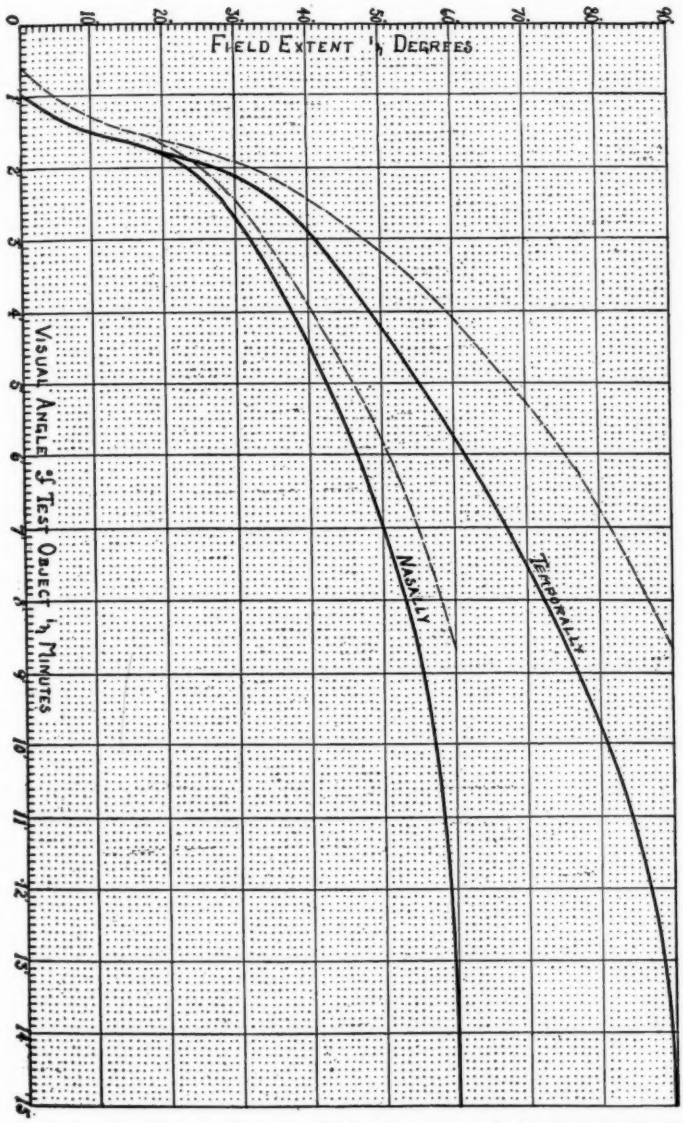


FIG. 3.—Plot of the variation of the field extent with the visual angle of the test-object. The heavy lines indicate the values given by the average individuals of good eyesight. The dotted lines indicate the values given by experienced observers.

we would then be inclined to return and go in the opposite direction until a good idea of the patient's normal with respect to the standard normal is obtained before examining more closely the defective region. This has become a general rule because better visualization of the defect by the observer and more accurate observations of the defect by the patient are obtained after this preliminary procedure has disposed of the more normal and less important part of the field.

4. *Difficulties in Reading and Recording Measurements.*—These difficulties are readily overcome by making the instruments and charts more rapidly readable, thereby releasing more concentration to the memory and visualization processes. In the case of the perimeter, which has been previously described,[1] a very large face is used, representing from 35 degrees to 90 degrees of field extent. Lines representing the field and single numerals representing the degrees at every intersection are stamped in the metal on front and back. These stampings are deep enough so that they are still readily visible from any direction when painted over with the dead black finish.

Mechanical perimeters do not answer our requirements of flexibility and rapidity and have numerous other shortcomings discussed in the previously mentioned references; but particularly in this connection it may be mentioned that mechanical records tend to inhibit the practice of visualization.

This general method of mapping, marking directly on the instrument as large an area of field as practicable about the fixation-point, has been found exceedingly useful, and has been extended to screen and umbrella devices, so that they become as readily readable as the perimeter. The discussion of these factors may proceed with the description and use of devices.

Screen Tests.—Having discarded the use of pins or protractor rulers as being too time-consuming and distracting to the patient, and having further decided from the same standpoint that continuous fixation on the center of the screen, rather than alternately on the edges, was desirable,

[1] Walker, "Bitemporal Hemianopsia," ARCHIV. OF OPHTHAL., xliv., No. 4, 1915.

it became clear that we must either have several markings on one screen corresponding to the different distances used, or several screens with markings for one distance only on each screen. We have tried both methods extensively, carefully recording data and calculations in order to select the most efficient devices from a practical standpoint. This has led to a study of numerous factors.

Visual Angles.—First the visual angle for each disk in our series was calculated and tabulated for all the useful distance intervals (*cf.* Fig. 1). These visual angles in minutes are readily obtained by multiplying the disk diameter in millimeters by the constant 3437·7, and dividing the result by the distance in millimeters, thus: $\frac{\text{disk diameter}}{\text{distance}} \times 3437{\cdot}7 =$ visual angle in minutes. Slide rule computations were used and are sufficiently accurate. But still quicker and even more accurate is the use of the plotted chart shown in Fig. 2. This chart is very advantageous, since it renders the subject more universal, and should be useful to any who wish to devise screens for any given size of disk or any distance that happens to be available. Lines are drawn on the chart for each commonly used distance. To get the visual angle for any disk size up to 5*mm*, one simply reads off the coördinate on the horizontal axis corresponding to the disk diameter on the vertical axis with reference to the proper distance line. For any other distance find the point representing it on the distance scale and draw a straight line through that point and the zero-point of the coördinates and proceed as before.

The Normal Field.—Then a systematic study was made of the size of the normal field for each available visual angle. A visual angle may be unavailable because the field is too large for the screens (above upper heavy line in table), or because it is too small to give a field of any useful size (below the lower heavy line in table) (Fig. 1). All disks can, of course, be used on the perimeter, even down to a visual angle of 1.5 minutes, as we have shown elsewhere,[1] but below 7·5 minutes or 0.6*mm* diameter on the perimeter the necessary

[1] Walker, "Bitemporal Hemianopsia," ARCHIV. OF OPHTHAL., xliv., No. 4, 1915.

size of the disk handle becomes large in proportion to the disk size, so that one must warn the patient not to confuse the two. Therefore, although satisfactory work can be done on the perimeter, one may often save time by changing to the screen for visual angles of 5 minutes and below.

It is necessary to know the field size to expect with each visual angle in order to select the most efficient arrangement of screen sizes, distances, and disks to be used. Preliminary information on these points was obtained by the usual method of laborious calculations from a single screen, moving the

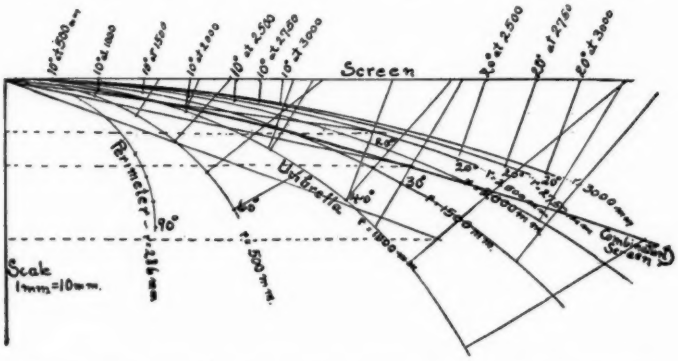


FIG. 4.—Scale drawing of various curvatures used, showing distance error and method of projecting field markings from one curvature to another.

patient back and forth for the various distances. From these data a preliminary curve similar to that shown in Fig. 3 was obtained, and it was decided that disks of about 1*mm* in size had by far the widest range of usefulness. Thus, by using the 1.2*mm* disk and a range of distances from 500 to 3000*mm*, a very satisfactory range of visual angles and field sizes was obtained. It was further concluded that the distances 500, 2500, and 3000*mm* were less useful than the distances 1000, 1500, 2000, and 2750*mm*.

As a further approximation toward more accurate data a scale diagram (Fig. 4) was constructed to compare errors at the various distances resulting from lack of curvature in the screen. While a screen can be calibrated so that its mark-

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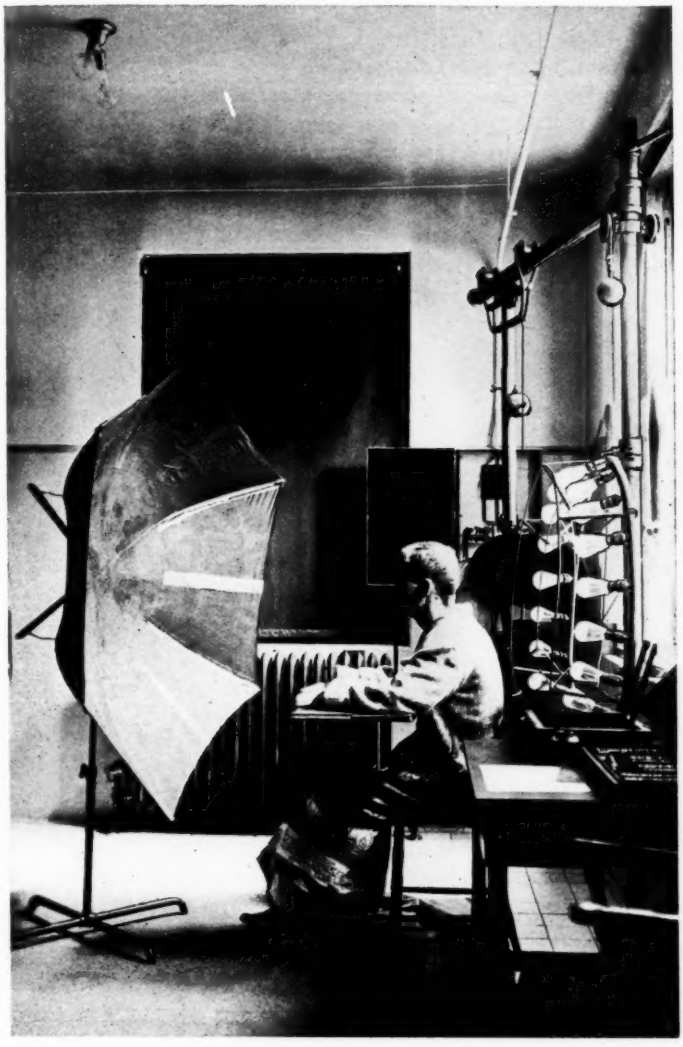

FIG. 5.—Photograph umbrella and stand with patient in fairly comfortable position.

ings, representing degrees' distance from the fixation-point, are accurate out to 50 degrees, the test-object at this point is 55 per cent. farther away from the patient than it is when at the fixation-point, consequently its visual angle is about one half as great exclusive of the further error that may occur if the disk is not tilted normally to the ocular direction.

By use of a scale drawing, such as shown in Fig. 4, the error at each interval can be quickly estimated with sufficient accuracy. Thus, at 10 degrees from the fixation-point on the screen placed normal to the line of vision at any distance from the patient the error is 1.5 per cent. increase in distance; at 20 degrees it is 7 per cent.; at 30 degrees it is 16 per cent.; at 40 degrees it is 32 per cent.; and at 50 degrees it is 55 per cent.

These errors in distances give the following errors in visual angles by use of the formula previously mentioned. At 10 degrees on the screen there is a 1.45 per cent. decrease in the visual angle; at 20 degrees this error is 6.4 per cent.; at 30 degrees it is 14.9 per cent.; at 40 degrees it is 26.2 per cent., and at 50 degrees it is 35 per cent.

Umbrella.—Above 20 degrees it is evident that there is considerable error, due to the increase in distance. In order to dispose of this error we first selected an umbrella which has a radius of 1000*mm*. The commonly used stock canopy umbrella has about this measurement. We have used umbrellas for similar purposes before, and so did the late Dr. Reber, of Philadelphia, and others.

An umbrella may thus be easily selected which is accurate along the ribs to a fraction of 1 per cent. The slight error between ribs is compensated by the chord of the arc in marking. For perimetric purposes such an umbrella must be supported from the convex side and lined with black material to conceal the ribs. As is shown in the illustration (Fig. 5), this support is accomplished by means of a frame like the spokes of a wheel, with wires extending from the spoke-tips to the mid-portion of the umbrella ribs. The umbrella is thus altered to be held open from behind by tension on these wires rather than by the usual construction. One of the iron spokes forming the back support is attached to a vertical telescoping pipe which may be clamped at any height, and

may be provided with foot-pieces carrying three-inch casters, as shown in Fig. 8. This gives a readily adjustable and movable piece of apparatus. Without the casters the apparatus is much more difficult to handle. The inner surface of the umbrella was then marked off about the center with circles at 10 degrees and radii at 30-degree intervals, thus representing an actual field chart. By this arrangement 45 degrees are available in all directions from the center and 50 degrees at the rib-tips. Moreover, since there is no correction at the various 10-degree intervals, eccentric fixation can be used, making a maximum of 80 degrees to 90 degrees available. As may be noted from the scale drawing (Fig. 4), the same circles which are accurate at 1000*mm* on this umbrella may also be used at 2000*mm* if numbered differently; that is, 20 degrees becomes 10 degrees and 40 degrees becomes 20 degrees, because the distance has been doubled. There is a slight error, however, due to the curvature, which will be considered later under the heading of errors.

Furthermore, if intermediate circles are drawn which will indicate the field at 500*mm*, the labeling can be changed to represent the field at 1500*mm* and 2500*mm*, as is indicated in the diagram of umbrella markings shown in Fig. 6. The numbers at the different distances are put on in different colors, thus reducing the difficulty of making proper readings. By this arrangement at 500*mm* we have very little error out to 40 degrees at 1000*mm*. The instrument is correct to 80 degrees or 90 degrees; at 1500*mm* 30 degrees are available with about one third the error of a screen at the same distance; at 2000*mm* 22 degrees are available with about the same error as before. These errors will be more fully discussed later.

Since the field extent for the 1*mm* disk at 2750*mm* is only a little over 10 degrees, the plain screen at that distance is sufficiently accurate.

Thus we had apparatus accurate enough to make a second approximation to correctness of the curve of field extent with respect to visual angle of test-objects of the previously mentioned curve.

The second approximation curve thus obtained enabled us to estimate more closely the errors possible at the distances of 1000*mm* to 2500*mm*, both on screens and on the um-

brella. In addition it was found that the umbrella described was a very handy instrument to work with, especially at 1000*mm*. For a single instrument of easy construction it is very efficient. However, with the data obtained at this

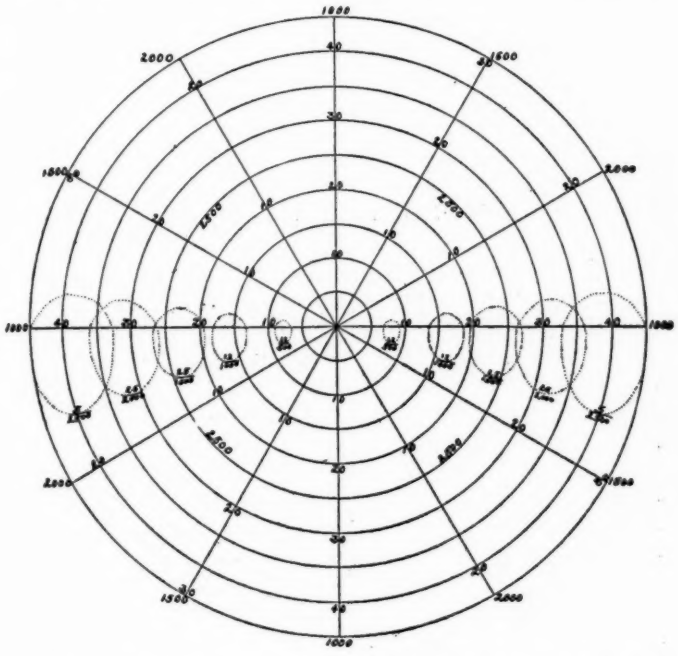

FIG. 6.—Scheme for marking any surface (umbrella) so that it may be used at various distances from 500*mm* to 2500*mm*. Eccentric fixation may be used to increase available field. Radius of 10-degree circle = distance used × 0.1745.

stage it was evident that we could construct a combination screen which would be considerably better, especially at the most useful distances at 1500*mm* and 2000*mm*.

New Combination Screen.—Having accumulated data of considerable accuracy regarding the field extent necessary for a screen at 1500*mm* and at 2000*mm*, it was possible to calculate the field measurements with considerable accuracy.

The screen, as built, has a width of 100 inches and a height of 80 inches. From a standing position all parts of a screen of this size can be reached without difficulty; still it will receive the normal field for disks of about 1*mm* in diameter. In order to avoid the necessity of using markings such as were described for the umbrella a special construction was resorted to which gives a separate set of markings for each distance, which we consider to be the ideal arrangement. That is, two screens of the size mentioned were sewed together along the horizontal meridian through the fixation-point (Fig. 7). Two leaves were thus provided, either one or both of which could be held up vertically by laying the horizontal rod held in the peripheral seam over the top support of the two back leaves of the screen, these latter being attached directly to the supporting frame. The leaves of the screen are thus held taut by the vertical gravity pull of the rods either when they are above or below the horizontal meridian (Fig. 8). It is obvious by this means that we can very quickly expose for use any one of the three surfaces available. Each one of the three surfaces is marked for a different distance.

However, the markings were not drawn on the screens until the curvature had been corrected to a satisfactory degree of accuracy. This correction was accomplished by running light iron rods through the horizontal and vertical seams passing through the fixation-point. At the crossing-point of these rods a tension wire was arranged to draw the central portion of the screen about twelve inches back from its peripheral edges, as shown in the profile (Fig. 7). Also it may be seen from this same figure that the screen is supported from the same frame which supports the umbrella. Having this combination screen stretched in its permanent position, the correct radii for the various circles about the fixation-points were obtained from a drawing on a large sheet of tough paper to actual size similar to that shown in Fig. 4. The circles were drawn on the screens with ordinary wax crayons. The meridians and the indication of the two-degree intervals, as well as the numerals at intersecting lines, were mapped out exactly as they appear on the new chart (Fig. 11), later to be described.

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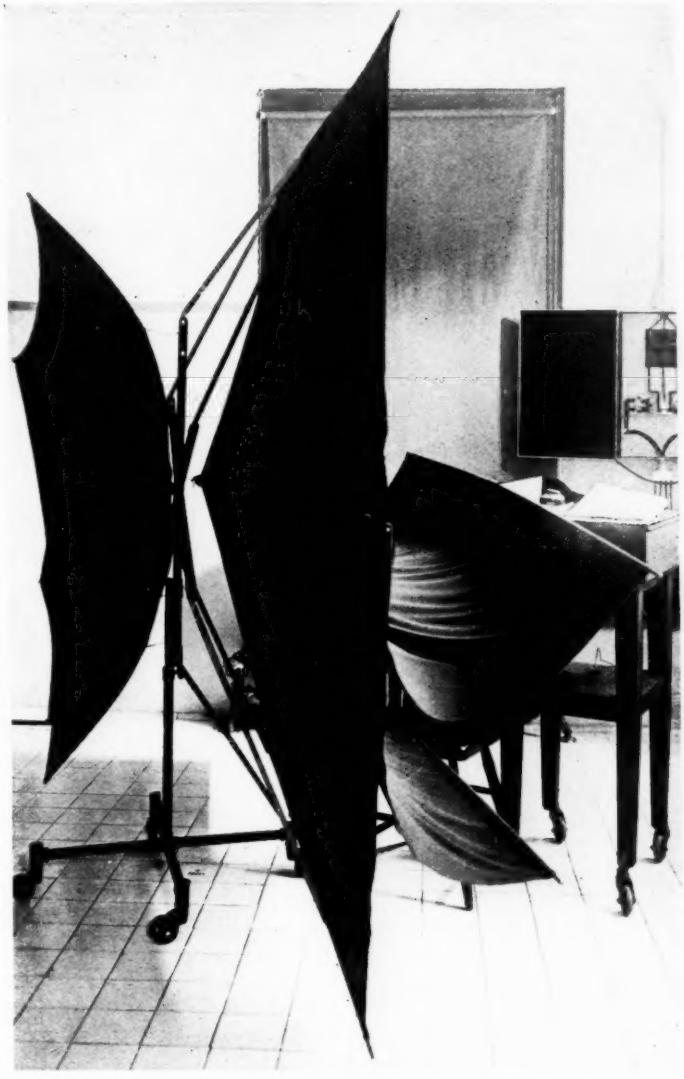

FIG. 7.—Photograph of combination screen and umbrella showing mounting and "leaves" of screen surface.

The available number of field degrees about the fixation-point obtainable on this combination screen are as follows: At 1000*mm* 50 degrees in the vertical meridian and 60 degrees on the horizontal; at 1500*mm*, 37 degrees vertically and 45 degrees horizontally; at 2000*mm*, 30 degrees vertically and 35 degrees horizontally; at 2500*mm*, 25 degrees would be available vertically and 30 degrees would be available horizontally; at 3000*mm*, 14 degrees vertically and 23 degrees horizontally. These last two distances, however, we do not use, choosing rather the plain screen at 2750*mm*, which is correct enough for the size of field obtained with disks about 1*mm* in diameter.

With this screen we have been greatly pleased because of its numerous advantages. In the first place, it is a very comfortable curvature to work on as compared with that of the umbrella. Again, all portions are readily reached from standing position, and readings are instantly made without the use of accessory devices. And, further, it is very easily moved to different distances and changed to the corresponding scale. Finally, it will always take the entire normal field for disk about 1*mm* in size, and it is accurate to a high degree, as we will discuss under the heading of errors. With this very practical instrument we were able to make a third approximation of the curve of variation of field extent with the visual angle of the test-object, particularly for the important distances of 1500 and 2000*mm*.

Field Extent vs. Visual Angle.—In this plot (Fig. 3), as in the other plot (Fig. 2), the endeavor has been made to make our values available to any observer, no matter what variation in size of disk or distance has been used. The perimeter or field reading is taken as the vertical coördinate and the visual angle as the horizontal coördinate. In this way a series of points are located for the range of visual angles available. Any individual thus examined will give one such a series. Each point in the series represents an average of a satisfactory number of readings for that particular visual angle. The readings were taken on the horizontal line, at the nasal and temporal peripheries, these points being taken as characteristic points of the normal field. The individuals used to obtain these readings from were persons of good ob-

servation power, though they had not previously been perimetrically observed, such as medical students, internes, nurses, or patients having normal eyesight. This grade of observation is represented by the heavy lines on the plot (Fig. 3), and is the one which we regard as a fair average of normal. If, however, we plot in similar manner the readings of good experienced observers, we obtain considerably higher values, as shown by the dotted curve. On the other hand, it should be stated that neurologic cases in general often give readings, in the relatively normal portions of their fields, that fall considerably below the normal curve indicated by the heavy line.

It is to be noted that for visual angles of 1.8 minutes to 2 minutes, which give fields from 20 degrees to 27 degrees in extent, the difference between the nasal and temporal measurement decreases to zero so that the field becomes circular for smaller visual angles. This shows itself in the plot by a union of the nasal and temporal curves in the neighborhood of 20 degrees extent. To obtain readings of the lower extremities of the curves, distances of four, five, and six meters were used.

It is obvious that we may take the reading of any observer who gives the disk diameter and distance used and locate it on this plot for comparison, by reference to the visual angle plot shown in Fig. 2. We have done this and find that the results of other observers check very badly with ours, especially for readings 30 degrees and above. There is a better check below 30 degrees, as, for instance, the result of Sinclair, who showed that field was almost circular and 26 degrees in extent for the 1*mm* disk at 2000*mm* distance.

It is possible that much of the discrepancy may be due to uncontrolled error resulting from the variations in the size of the disk or in the use of the plain screen. This leads us to a study of these possible errors:

ERRORS.—Generally speaking, there are numerous sources for possible error or variations in readings aside from those due to screen, disk, or distance errors. Probably the most important of these is due to illumination. Test-objects of small visual angles are considerably more sensitive to variations in illumination than the larger sizes, as we have shown

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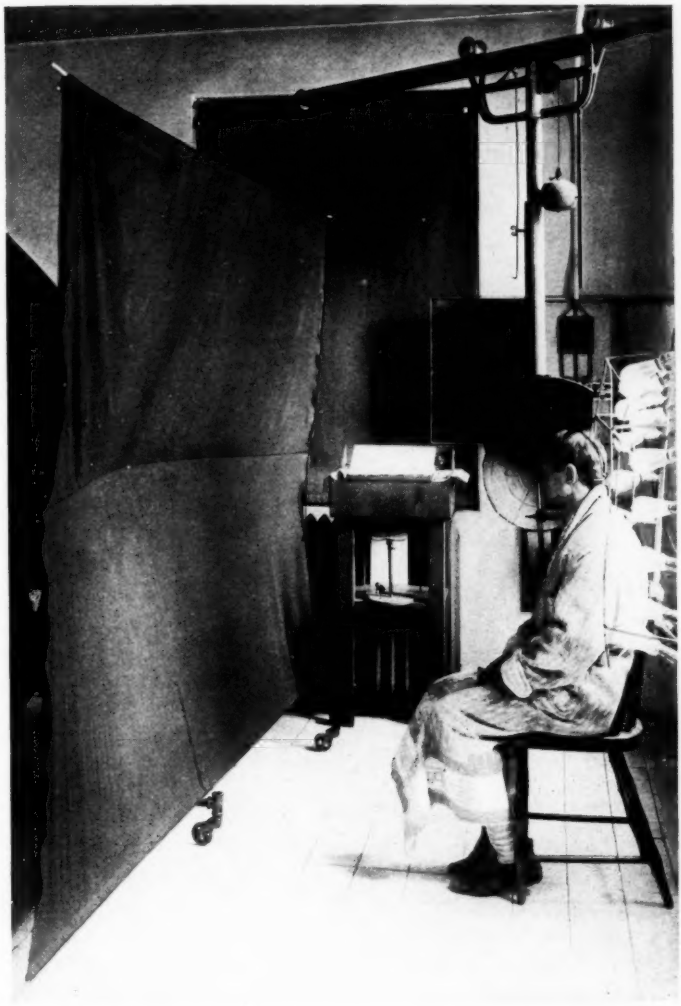

FIG. 8.—Photograph of combination screen surface with patient adjusted in position by means of suspension apparatus. Showing tall black stand used to convey writing materials, charts, and instruments. Patient's head fixed at proper distance by use of suspension perimeter chin-rest.

in a study of perimeter illumination.[1] Because of the distance at which screen work is done, the screens are usually poorly illuminated as compared with the perimeter, which can be kept nearer the source of illumination. While we are able to fortify daylight by use of electric lights, proper screen illumination at the various distances used is rather difficult, and as the distance increases the illumination decreases to a certain extent. To control this variable absolutely would require more apparatus than we have been able to install. However, it is more or less constantly variable with all observers. The material of which the screen is made influences the readings considerably; black velvet is, of course, the best surface, but black felt or broadcloth is a very good substitute. The wearing of a black gown and gloves helps greatly to give more accurate readings. The condition of the disks used as regards fading or soiling must be carefully watched and remedied. One other difficulty, that of refraction, is often well controlled by allowing the patient to wear his glasses during examination. It has also been found possible to simply hang the proper trial-case glass from the eyebrow by the use of a piece of adhesive.

The Plane or Tangent Screen Errors.—As we have said, the method we have used to estimate the errors involves the use of such a plot as that shown in Fig. 3. While this plot is as accurate as we can make it, it probably represents some slight amount of error. However, since such error is probably constant throughout, our method of determining the error due to distance will not be affected.

If we wish, for instance, to determine the error in the actual field reading at 40 degrees from the center on the tangent screen at 1000*mm*, we first determine the distance from the patient's eye to the 40-degree point. This distance is practically 1310*mm*. The visual angle of the disk which should give a reading at 40 degrees on a correct surface will be decreased on the plane screen in the ratio of $\frac{1000}{1310}$. Thus from our plot, for instance, we find that the visual angle of 2.9 minutes should give a reading of 40 degrees on the temporal side of the normal field. When this number is multi-

[1] Walker, C. B. *Trans. Amer. Med. Assn., Ophth. Section*, 1917.

plied by $\frac{1000}{1310}$, we find that the disk at that point on the screen has an actual visual angle of 2.21 minutes, which again from our plot would give a reading of 31.7 degrees. This would represent a decreasing error of 8.3 degrees.

However, this error is reduced in actual field taking because, as the disk moves from the 40-degree point inward toward the center of the field, its visual angle automatically increases. This reduces the error to the neighborhood of one half of the value mentioned. To find the error more accurately, the curve is involuted between the points represented by the two coördinates 2.21 and 2.9, which is practically the same as taking the average of these coördinates—2.55—and finding

DISTANCE ERROR ON TANGENT SCREEN

Field Extent	10°	20°	25°		30°		40°		50°		60°	
% Increase of Distance	1.6%	6.4%	11.0%		15.5%		31.0%		55%		100%	
			T	N	T	N	T	N	T	N	T	N
Necessary Visual Angle	1.48′	1.78′	1.92′	2.12′	2.12′	2.72′	2.9′	4.45′	4.22′	7.0′	5.75′	15.0′
Actual Visual Angle	1.456′	1.674′	1.73′	1.91′	1.84′	2.365	2.21′	3.4′	2.72′	4.52′	2.87′	7.5′
Average	1.468′	1.732′	1.825	2.015′	1.98′	2.54′	2.555′	3.925′	3.47′	5.76′	4.31′	11.25′
Corresponding Field	9.9°	19.0°	21.7°	25.5°	26.8°	28.5°	36.5°	37.3°	44.5°	45.0°	50.7°	58.5°
Error in Degree of Field	0.1°	1.0°	3.3°	1.5°	3.2°	1.5°	3.5°	2.7°	5.5°	5.0°	9.3°	1.5°

FIG. 9.—Table of errors on plane or tangent screen due to distance.

the corresponding field value on the plot,—36.5 degrees,—which gives an error of 3.5 degrees (Fig. 9).

Because of the difference in the curve for the nasal and the temporal fields, the error correspondingly is different, being sometimes twice as large on the temporal side between 20 degrees and 40 degrees from the center. At 20 degrees the error due to this source begins to exceed 1 degree of field, gradually increasing until a maximum error of 5.5 degrees is reached at 50 degrees from the center (*cf.* table, Fig. 9). It is to be noted that this table of errors is constant for the normal field no matter what screen distance is used.

It is obvious that these errors could be compensated by shrinking the size of the circles on the screen to an extent corresponding with the error at the various points. The only difficulty with this method would be the fact that the error

is different for the nasal than for the temporal field, and the fact that the actual visual angle of the test-object used is variable. Nevertheless, it is the least that can be done toward correction. It simply adds an empirical correction to the already applied geometric or tangent correction.

Umbrella Errors.—The umbrella, marked as indicated in Fig. 6, is correct for 1000*mm* distance, and if eccentric fixation is used, 80 degrees to 90 degrees field may be obtained practically without error. Eccentric fixation, however, can be used on only one meridian at a time, and is rarely used in routine examination except in studies of this sort.

When the umbrella is used at 500*mm*, we have an increasing error due to the method of marking, as will be noted from a study of Figs. 4 and 6. The error due to curvature is happily a decreasing error of similar magnitude. These two errors neutralize each other out to 40 degrees, where there remains a 0.7 degree increasing error. At 50 degrees this error becomes as large as 3 degrees of field. It is evident that 40 degrees from the center is available and 80 degrees in case eccentric fixation is used. These errors are calculated in the same manner as for the plane screen.

At 1500 the error is negligible until 30 degrees from the center is reached, where it reaches 1.2 degrees in magnitude. Eccentric fixation will permit measurements of 50 degrees and 60 degrees with no increase in error.

At 2000 and 2500 the umbrella is not so accurate as at other distances, but still is about 25 per cent. more accurate than the plane screen in the 30-degree and 40-degree regions when eccentric fixation is used, being 2.5 degrees. Thus the umbrella when marked as described is a very practical instrument, although the combination screen is better for distances of 1500*mm* and more.

Combination Screen Errors.—At 1000*mm* on this screen the error does not exceed 1 degree until 40 degrees is passed. At 50 degrees there is a maximum decreasing error of 3.5 degrees. By using eccentric fixation, 60 degrees to 80 degrees are available without error over 1.2 degrees, but, of course, the umbrella is best for accuracy in these regions.

At 1500*mm*, however, the combination screen is better, having an error of less than 1 degree at 40 degrees. By using

eccentric fixation, 60 degrees or more are available. At 2000*mm* the combination screen is practically correct, having a maximum error of 1.5 degrees as far out as 30 degrees. This available space can be increased to 50 degrees or 60 degrees by eccentric fixation.

At 2500*mm* the maximum error occurs at about 20 degrees and is 0.7 degree. At 30 degrees the error becomes zero, and 40 degrees from the center are available without increasing the error above 1 degree. More field can be obtained by eccentric fixation, but can seldom be used at this distance.

Disk Errors.—Having noted the difficulty in making small disks to exact measurement, we determined to estimate the error due to a variation of 0.1*mm* above or below the diameter desired. This is a very easy error to make in cutting paper disks, unless a steel die is used to punch them out exactly right, as has been done in making our disks. In order to estimate the possible error from this source, we make the supposition that one observer has a disk actually 1.1*mm* in diameter which he is using as a 1*mm* disk, while the 1*mm* disk of another observer actually measures 0.9*mm* in diameter.

Now by use of the plot (Fig. 2) we can readily find the corresponding visual angle for each of these diameters when used at the various distances. Then, by reference to the plot (Fig. 3), we may find the field which should be gotten with each visual angle. The difference in these field readings would indicate the possible error in field degrees. From these data, as shown in the table (Fig. 10) it may be noted that the maximum difference between the readings of two such observers may vary theoretically from 11.7 degrees at 2000*mm* to 4 degrees at 3000*mm* depending on the character of the field curve at the various points.

Distance Error.—While the distance from the patient's eye to the screen is a very easy matter to control, and should not be allowed to become a source of error, we will, for completeness, make an estimate of the possible magnitude of such errors. If we assume in one case that the patient's head is 5*cm* too far forward and in another case 5*cm* too far back, we can determine the corresponding effect on the visual angle of disks about 1*mm* in diameter. From our plot, as before, we may estimate the difference in readings

in the two cases. The maximum difference may rise as high as 8 degrees at 500*mm*, but decreases as the distance increases. At 1500 there will be a 3-degree difference which decreases to 2 degrees at 2000 and 1 degree at 3000*mm*. To avoid these errors, of course, requires only a little care. We have used a small chin-rest standing at proper distance on a black table, but prefer rather to use the suspension perimeter chin-rest with the perimeter itself turned 90 degrees to the side. The chin-rest and eyepiece are correspondingly

ERROR IN DISC DIAMETER

Distance	500			1000			1500			2000			2500			2750			3000		
Visual Angle of 1mm Disc	6.87′			3.44′			2.29′			1.72′			1.38′			1.25′			1.14′		
Vis. Ang. Error of ½mm Disc	±0.7′			±0.35′			±0.23′			±0.175′			±0.152′			±0.134′			±0.115′		
Vis. Ang. Corresponding to 0.9mm, 1.0mm & 1.1mm Discs	+7.57′	6.87′	−6.17′	+3.79′	3.44′	−3.09′	+2.52′	2.29′	−2.06′	+1.895′	1.72′	−1.545′	+1.53′	1.36	−1.230′	+1.375′	1.25′	−1.125′	+1.255′	1.14′	−1.025′
Nasal and Temporal Field Corresponding to above Vis. Angs.	N 53.0° T 70.0°	N 49.0° T 66.5°	N 45.5° T 63.0°	N 36.7° T 67.0°	N 34.7° T 64.0°	N 32.4° T 61.8°	N 28.7° T 56.5°	N 26.8° T 53.4°	N 24.0° T 48.7°	N 23.3° T 81.5°	18.0°	12.6°	11.0°	7.3°	4.5°	7.3°	4.5°	2.4°	4.5°	2.3°	0.5°
Maximum Error Nasally	7.5°			5.2°			4.7°			9.5°			6.5°			4.9°			4.0°		
Maximum Error Temporally	9.2°			6.1°			8.7°			11.7°			6.5°			4.9°			4.0°		

FIG. 10.—Table of errors that may be due to a variation of 0.1*mm* in disk diameter.

turned (Fig. 8). Marks are placed on the horizontal ratchet and on the vertical telescoping tube so that the apparatus may be quickly adjusted. The adjustment of the line of vision to normality at the fixation-point with the screen surface is not difficult, since the supporting apparatus is adjustable as to height and the plotting board effect of the square tile floor fortunately makes further adjustment easy.

Altogether it seems evident, from a study of the various sources and magnitudes of error in quantitative perimetry, that, unless considerable effort is made to standardize and control numerous variables, the results of different observers will fail to check to a considerably greater extent than in ordinary perimetry, where the pitfalls are far less numerous. This should be done, since unquestionably quantitative perimetry is the most valuable and fruitful method of determining important early functional disturbances in the optic

nerve and retina. To make a suitable complete field record is a most important part of these examinations, and we wish now to submit a chart design which has served our purposes admirably.

The New Perimetric Chart.—As previously mentioned, the ordinary chart offers some difficulty in making rapid records by our method. Accordingly, we have constructed a new chart in order to avoid many of these difficulties, as well as to secure numerous advantages which we will discuss while explaining the construction of the chart.

The chart was drawn about twice the size finally desired in order to obtain very fine lines in the reproduction. This we consider extremely desirable in order to make the field itself stand out well, especially when a large number of contours are drawn on the chart with ordinary ink. The two visual fields are joined together nasally in the usual manner. The 63-degree point on the horizontal line is taken as the most efficient position of union with regard to the saving of all necessary space, and still giving satisfactory extent nasally. This space is saved because we desire to make other positions of the chart as large as possible. The ultimate size of the reproduction is limited by the size of our ordinary hospital history page, 9¼ by 13 inches.

Even with this enlargement, however, it is desirable to have still further enlargement about the center of the field in the regions where the records for the smaller visual angles occur, namely, that portion of the field within the 30-degree circle. Previous attempts have been made to get this very desirable larger scale for the smaller visual angles, resulting usually in a separate chart for screen work or a double scale on a visual chart. We have overcome this difficulty for our purposes very satisfactorily by the simple device of using a modified Mercator projection scheme. That is, the distance representing 10 degrees at the center (0 degree to 10 degrees) has been made double the distance representing 10 degrees at the periphery (80 degrees to 90 degrees). This we have found to give ample space to record all sizes of disks on the same chart, thus avoiding the confusion of double charts or double scales. The true Mercator projection is not satisfactory peripherally.

The blind spot is carefully outlined as accurately as possible with regard to the normal size, shape, and position in the field. The chart also has a definite place for recording the vision, name of patient and observer, and the date. We use flat circular disks and prefer the notation of Bjerrum, —disk diameter over distance,—written directly on the line representing the field for the disk used.

The 30-degree meridians are put in solid with fine dots every 2 degrees. The 15-degree meridians are also put in, but are represented only by dots every 2 degrees. The meridians are numbered in the same manner as the axis in refraction.

We have further found it a great aid to have every intersection of lines labeled with a single digit representing degrees from the center. The central region has been kept as free as possible by erasing all lines within the 1-degree circle, leaving only a small dot to represent the exact center.

The dark portions of the field nasally, above, and below, while not being really necessary, seem to add somewhat to field orientation. The usual brow, nose, and cheek shadows are omitted, since they represent an artificial and not a true limitation of the field, as shown by eccentric fixation. These areas are laid in by the so-called "Ben Day process."

The charts are printed with a terra-cotta ink, for two reasons: First, the black lines of the field drawn on the chart show up better against a colored background; still it is undesirable to use any of the ordinary field colors. Second, we desire a color that will photograph well in case we desire to reproduce it, although we also have black charts for this purpose.

The charts are printed on a sufficiently thin, tough, Chinese linen-bond paper, so that if two charts are superimposed in register, one of them having a field already drawn on it, and held against a window-pane or light surface, the field will show then so that it can be readily and quickly traced on the other chart. This is a very comfortable short-cut in case it is desirable to send out copies. If, however, there is not time for this, and photographic materials are at hand, or if the chart can be sent to a photographer, it may be handled exactly as if it were a negative or ordinary tracing

cloth, and blue prints or other prints can be made quickly and cheaply. These prints are perfectly readable, being negative only in respect to color.

The various features of the chart may be noted in Fig. 11, which also shows a series of normal outlines for various visual angles corresponding to the heavy curve in plot (Fig. 3). Again, in Fig. 12 a field record of a pituitary case is given to

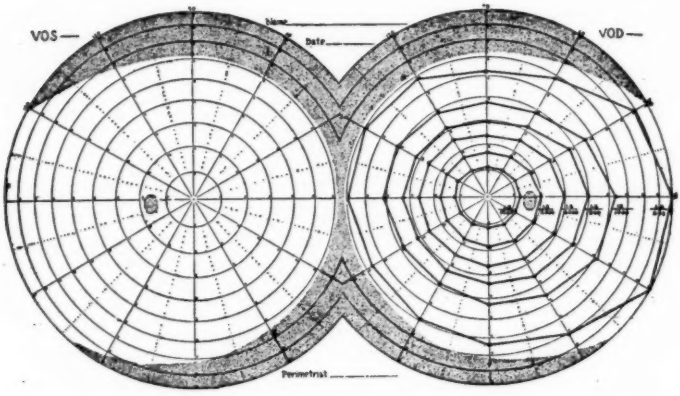

FIG. 11.—Field chart designed to receive complete field record of all visual angles used, avoiding the use of two charts or two scales. To the right the normal field readings are given corresponding to the plotted values (Fig. 3). Reduced ⅓.

show the carrying capacity and legibility of the charts. They are reduced in these figures.

In conclusion we may note that it seems certain that the results of various observers using quantitative perimetry may fail to check by rather large margins as regards the absolute measurements, though the diagnosis may not thereby be affected, since the errors are usually constant throughout an examination. The possibility of making these errors increases as the visual angle of the test-object decreases below fifteen minutes. To reduce these errors to a minimum the disks and distances used must be accurate; the surfaces used should be of high-grade reflexless black material and of approximately correct curvature. The test-object should be a

clean, reflexless white, and practically rimless. Black gown and gloves should be worn by the examiner. Probably if these factors were controlled the results would be sufficiently uniform, though illumination difficulties would still be a

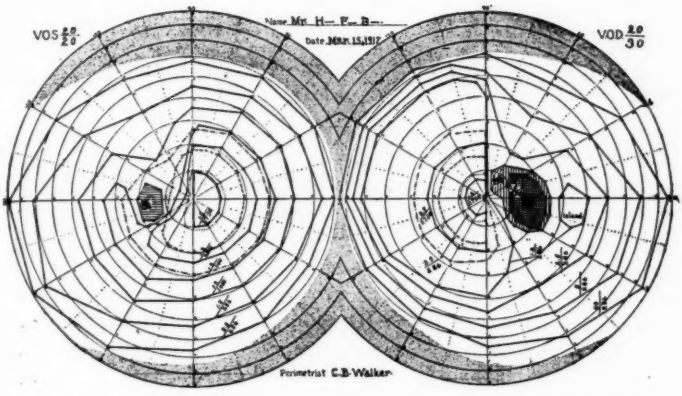

FIG. 12.—A pituitary field to show capacity of new chart. Reduced ⅓.

potential source of variable results. This latter factor can be controlled by artificial illumination at some expense. We are convinced that mechanical methods of making any but very ordinary records are unserviceable in modern perimetry, and that by use of convenient apparatus, such as described, and by cultivating memory of readings, better records may be obtained, since thereby the observation power of the patient is conserved. Without doubt the use of small visual angles has and will increasingly continue to enlarge the confines of our knowledge in the field of perimetry.

HETEROCHROMIA IRIDIS, HETEROCHROMIC CYCLITIS, AND ALLIED CONDITIONS.[1]

By Dr. E. C. ELLETT, Memfhis, Tenn.

THERE is no doubt that there is a definite clinical and pathologic picture or syndrome to which Harrison Butler has given the name of heterochromic cyclitis, but as the condition is by no means common, it happens that many men have not had it called to their attention. On account of its importance from a prognostic point of view, and from the fact that the condition has not impressed itself on a number of practitioners with whom I have spoken, it seemed to me that the report of a few more or less related cases might possess some interest. In collecting the material for this report there were several cases which presented the development of the picture as far as the onset of cataract, and two in which glaucomatous symptoms were added. There were some other cases, of great interest to me, and which presented the association of glaucoma with uveitis, which I have included in the report under the subtitle of "allied conditions."

By heterochromia iridis we mean a condition in which the iris of one eye differs in color from that of the other. We do not include cases of different-colored sectors in an iris whose background is of the same color as that of the fellow-eye, but those cases in which the whole iris is of the same color, but different from that of the other eye. This condition is not rare, and it usually occurs in brunettes, and is noticed at birth or in early life, certainly before maturity, in the large majority of cases. It has been stated that one eye has the color of the father's eyes and the other that of the mother's, but this observation could be true only in case the condition was present as a congenital anomaly, and not in those cases

[1] Read at meeting of the American Ophthalmological Society, 1917.

which are supposed to be distinctly pathologic, and which are the ones of most interest to us. As a corollary to this statement we find it further recorded that the difference in color may arise in one of two ways—either that no pigmentation occurs in one eye, or that it occurs and is subsequently lost through some pathologic process. The pathologic changes are almost invariably observed to occur in the lighter-colored eye. There are a few exceptions to this, but very few. These changes consist in:

1. *Evidence of a Chronic Low-Grade Cyclitis.*—Rarely is there any ciliary injection or manifest changes in the iris or choroid, or subjective symptoms, such as would attend these changes. What we do find are vitreous opacities and deposits on the posterior surface of the cornea. In my experience, the vitreous opacities are much the more frequent.

2. *Development of Cataract.*—The peculiarities of this cataract are, in the first place, the youth of the patient, since it generally appears before the age at which we would expect to see cataract. It would be well to examine carefully the cases of juvenile cataract, not of the zonular type, and cataract occurring in persons under fifty, and limited to one eye, for evidences of heterochromic cyclitis. Another peculiarity of this cataract is that the other eye is, and remains, free from a similar disorder. The cataract pursues an irregular course, but since the progress of all cataracts is extremely uncertain, it is perfectly regular as regards this feature. It tends to progress to maturity and there is no contraindication to its removal.

3. *The Development of Glaucoma Simplex.*—This is by no means the usual termination of this disease, as only a few such cases are recorded. I have seen only two such myself, although it has been carefully looked for. The glaucoma may follow extraction of the lens, or it may occur in an eye in which the cataractous lens is still present.

We may say at once that the underlying cause of this condition is not known. Most of the speculation on the subject is along the lines of a lesion of the cervical sympathetic. Such a lesion is not a vague and indefinite thing, but a very definite thing, and may result from injury, from the presence of tumors, from involvement in inflammatory or malignant

processes, the pressure of scars, aneurysm, disease of the spinal cord or vertebræ, cervical rib, and certain affections of the lungs, all of which may cause either irritation or paralysis, and none of which should the resources now available for purposes of diagnosis fail to reveal. Idiopathic paralysis of the cervical sympathetic is said to occur (Weeks).

The relation of the cervical sympathetic to the eye is pretty clearly understood, and is well set forth in that part of the symposium on the subject contributed by Dr. DeSchweinitz before the Section on Ophthalmology of the American Medical Association, 1903. According to his conclusions, based on a thorough study of the experimental work and on clinical observations, the effects of section of the sympathetic or removal of a portion of the nerve or one or more of its cervical ganglia, are temporary, and consist of changes in the size of the pupil, slight changes in intraocular tension, vascular changes, and possibly trophic changes. There is not much in this catalogue of effects to suggest a very great influence in bringing about the changes under consideration. If disease of the cervical sympathetic is potent as a cause of glaucoma, the removal of certain of its ganglia was not followed by such results as to give the procedure a permanent place in the measures advocated for the relief of that disease.

If it can be established that the cyclitis preceded the heterochromia, it is not necessary to look beyond the eyeball itself for an explanation of the whole process. Discoloration of the iris is always present when that membrane is inflamed, and a chronic uveal inflammation affecting the anterior segment could, of course, account for a permanent alteration in the color of the iris.

Several cases of injury to the cervical sympathetic have already been reported from the European battlefields, and while a variety of other symptoms have been noted, there has been nothing remotely suggestive of such symptoms as these we are now considering. Nevertheless, other cases have been recorded of injuries to the sympathetic during birth and in other ways in which heterochromia iridis followed.[1]

[1] M. S. Mayou, *Ophthalmoscope*, vol. xiv., p. 421; *Trans. Oph. Soc. Unit. Kingd.*, 1910, vol. xxx., p. 196; "Sympathetic Paralysis and Cervical Rib, two cases. No Heterochromia," *Ophthalmoscope*, vol. civ., p. 313.

That the pathologic changes are not the same in all cases, or at any rate have not always been interpreted in the same way, is indicated in the following quotation from Lutz:

"The pathologic-anatomic researches of Scherl point to an absence of the mesodermal pigment in the iris and choroid. Those of Fuchs, however, point to changes in the iris and in the outer layers of the retina, which in all probability may be considered to be the sequel of a chronic inflammation."

Since Jonathan Hutchinson first mentioned the condition[1] several more or less extensive studies have been made of it, especially by Sym,[2] Fuchs,[3] Lutz,[4] and lastly Harrison Butler.[5] From the last two I have borrowed information freely.

Lutz reported 17 cases. In about one-half of them there were present such evidences of chronic inflammatory processes that the heterochromia partook of that type which we might expect to see in chronic iridocyclitis. The ages of the 17 patients at the time when the heterochromia was first noticed were as follows: At birth, 7; in first decade, 1; in second decade, 5; in third decade, 4. In the 17 patients, opacity of the lens or its capsule was seen 11 times; vitreous opacities, 10 times; and glaucoma, 3 times. Usually more than one of these conditions were present in the same case.

The conditions to which I have referred under the subtitle of "allied conditions" do not properly belong here at all, but it is because of the difficulty of properly classifying them that a brief reference to them is included and a few cases reported to better illustrate what I mean. They will be seen to be cases of chronic uveitis, presenting vitreous opacities alone or vitreous opacities with visible evidences of inflammatory processes in the uvea, either in the iris, ciliary body, or the choroid. Associated with or following these changes is an increase in intraocular tension. When this is present as an accompaniment of iritis, there seem to be two classes of cases—one in which the usual treatment of iritis is fol-

[1] *Royal London Oph. Hospital Reports*, 1869.

[2] *Ophthal. Review*, 1889, ten cases.

[3] *Klin. Monats. f. Augenheilk.*, September, 1906; *Zeitsch. f. Augenheilk.*, 1906; *Lehrbuch f. Augenheilk.*, 1902.

[4] *Zeitschrift f. Augenheilk.*, Bd. xix.

[5] *Ophthalmoscope*, vol. ix., p. 501.

lowed by a subsidence of the hypertonus, and another group in which the hypertonus is aggravated by atropin. The differentiation of these two is difficult, and the management of the second group is even more difficult. Some of the difficulties will be indicated by perusal of the case histories.

My own cases, 12 in number, are as follows: Cases 1, 2, and 3, heterochromia iridis with uveitis; cases 4 and 5, heterochromia iridis with cataract; cases 6 and 7, heterochromia iridis with cataract and glaucoma; cases 8, 9, 10, 11, and 12, uveitis with some attendant discoloration of iris and glaucoma.

CASE 1.—*Heterochromia Iridis with Vitreous Opacities and Choroidal Lesions in the Lighter Eye* (*Heterochromic Cyclitis*).—Miss Mc., aged twenty-six years; January, 1917, noticed black spots before the left eye for a few weeks. Fine vitreous opacities and a few small pigment dots in choroid in extreme nasal part of field. Heterochromia iridis. Left eye lighter. Wassermann negative. The teeth are bad, and there are a few pus-cells in the urine. The heterochromia has always been present. V. O. D. = 20/20 and J1; O. S. = 20/25 and J6. Tension normal.

CASE 2.—*Heterochromia Iridis with Vitreous Opacities in the Lighter Eye* (*Heterochromic Cyclitis*).—W. T., aged twenty-eight years, was seen January 1, 1913, for correction of refraction. V. O. D. = 20/40. Homatropin sph. − 1.50 = cyl. + 3.50 ax. 90° = 20/20; O. S. = 25/70 − sph. − 3 ⊂ cyl. + 4 ax. 90° = 20/20 − 1. Ophthalmoscopic and external appearances normal. November 8, 1916, palpebral conjunctivitis. O.D. 20/60 sph. − 2.00 = ⊂ cyl. + 3.50 ax. 90° = 20/20; O. S. 20/80 cyl. − 4.00 ax. 180° = 20/20. Heterochromia iridis, the right eye being the lighter. Vitreous opacities right eye. Fundus normal; lenses clear; tension normal; cornea clear.

CASE 3.—*Heterochromia Iridis—History of Lues, and Disseminated Choroiditis in the Lighter Eye. Media Clear* (*Heterochromic Cyclitis*).—J. G., aged forty years, was seen May 2, 1916. Nineteen years previously he had contracted syphilis, for which he was treated for four years and pronounced cured. Two years ago he had the first complaint with his eyes, which were sore, and the vision was blurred. At this time he had a positive spinal fluid, and received six doses of salvarsan. Since that time he has had occipital headaches. V. O. D. = 20/25; cyl. − 0.75 ax. 15° = 20/20; O. S. = 20/20; accepts sph. + 0.25. The right iris is decidedly lighter than the left. There are a narrow staphyloma posti-

cum and a few lesions of disseminated choroiditis. The pupils are equal and active and tension normal to fingers.

CASE 4.—*Heterochromia Iridis. Cataract in the Lighter Eye.*—G. R., aged eighteen years, was seen February 22, 1916. Complaining of failing vision for three months in the left eye. V. O. D. = 20/20; O. S. = 6/200. Nuclear opacity of left lens. Eye otherwise normal. He was given two subconjunctival injections of mercury cyanid without benefit, the vision gradually failing to the ability to count fingers. January 3, 1917, the left iris was noted for the first time to be lighter than the right. The cataractous lens was removed by discission.

CASE 5.—*Heterochromia Iridis—Cataract in the Lighter Eye. Vitreous Opacities.*—F. G., aged thirty-three years; January 7, 1914, complains that the vision of right eye has always been poorer than the left, and for six or eight years he has known that the right eye was lighter in color than the left. A mature uncomplicated cataract was seen in the right eye, the iris of which is a light gray, that of the left being brown. The cataract was extracted from the right eye with vision 20/25. In November, 1916, the right iris was thought to be still lighter, vision same, tension normal (tonometer), and a few fine vitreous opacities are to be seen.

CASE 6.—*Heterochromia Iridis with Capsular Opacities and Glaucoma. Evidence of a Past Iridocyclitis (Heterochromic Cyclitis with Glaucoma).*—Miss C. N., aged fourteen years, was seen February 15, 1917. The right eye has always been blind and has looked just as it does now since birth. Her father and mother both had brown eyes.

O. D.: Iris grayish green in color; diameter of cornea, 10*mm.* At the inner and outer ends of the horizontal diameter of the cornea is a short vertical and slightly curved corneal opacity. Anterior chamber of normal depth. The pupil is fixed by many posterior synechiæ and is filled with a delicate gray membrane attached to the anterior capsule. Tension + 2, with McLean tonometer, 70*mm.* The eye is blind. No deposits on the posterior surface of the cornea.

O. S.: V. = 20/25 and J1. Iris brown, pupil and tension normal, refraction (homatropin) sph. + 0.75. Nose and sinuses normal. Has had tonsils and adenoids removed. No evidence of irritation or paralysis of the sympathetic.

CASE 7.—*Heterochromia Iridis—Cataract and Glaucoma in the Lighter Eye. Vitreous Opacities in Same Eye (Heterochromic Cyclitis).*—Miss R. L., aged about forty-five years, was seen April 30, 1910. She gave a long history of trouble with the right eye of an inflammatory nature. She thinks the vision in right has always been less acute than left, and was then O. D. = 20/200; sph. − 5.50 ⌔ cyl. − 1.75 ax. 90° =

20/80; O. S. = 20/25; cyl. 1.50 ax. 180° = 20/20. She had worn glasses of about this formula for twelve years. The right eye showed vitreous opacities and a posterior cortical opacity. The left eye was normal.

May 20, 1916, the patient consulted me again for acute conjunctivitis. Heterochromia iridis was then noted, the right being a light blue and the left a yellowish gray and much darker than the right. She says the difference existed when I saw her before. O. D.: counts fingers at 2 ft. Pupil 5*mm* and active. The iris looks thin and smooth, especially at the pupillary margin, as if atrophic. There is a large central lens opacity. Tension 52*mm* (Gradle), and 60*mm* (McLean). The left eye is normal. This lady has been from time to time under the care of Dr. deSchweinitz, who noted the heterochromia in 1906, at which time a few pin-point pigment dots on the capsule bespoke a form of iritis. There were present, then, the lenticular and vitreous opacities, a pallid disk, which was not cupped, and much choroidal disturbance. In November, 1916, she was again his patient with an attack of acute glaucoma.

CASE 8.—*Uveitis with Lenticular Opacities. Glaucoma.*—D. Y., aged forty-eight years, was seen February 16, 1912, complaining of a spot before the left eye for six months. V. O. D. = 20/20; O. S. = 20/70. Vitreous opacities in the left eye.

March 19, 1915, O. D. = 20/25+; O. S. = $\frac{5}{200}$. Vitreous opacities and a curved lenticular opacity in the lower inner quadrant. Fundus normal. The patient was in the office with another member of his family and the eye was hastily examined and he was to return. May 27, 1915: There is vision in the temporal field only. The vitreous and lenticular opacities are more dense. Tension 57. Right eye is normal. June 11th: Tension 63*mm*. June 12th: La-Grange iridosclerectomy performed on left eye. August 19th: The operative result is good. Tension 17*mm*., nerve cupped, good filtering scar. June 30, 1916: Tension O. D. 28*mm*; O. S. 57*mm*. Lens more cloudy in O. S. August 14, 1916: Tension O. S. markedly elevated to the touch. No pain.

In January, 1916, the patient saw Dr. Calhoun, of Atlanta. The tension of the right eye was 17, but the field was contracted to 15°. When I saw him next in June, 1916, the field was normal.

CASE 9.—*Simple Glaucoma in Right Eye. Uveitis and Glaucoma Developed Subsequently in Left Eye.*—J. R., aged fifty-four years, was seen April 17, 1914, complaining of pain in both eyes and impaired vision in the right. The failing vision was first noticed three months ago, and for one month

the right eye has been blind. V. O. D. = 0; O. S. = 20/30. Pupils 5*mm* and 3.5*mm*; tension O. D. 57*mm*; O. S. 24*mm* (Gradle). The right disk is cupped, left normal. Left field is normal. Eserin was prescribed for use in right eye.

November 6, 1914, V. O. S. = 20/40 with sph. − 0.50 ⊂ cyl. − 0.50 ax. 90°; pupil sluggish; pain in eye at times; tension 42*mm* (McLean) and 32*mm* (Gradle); keratitis punctata, and one adhesion and a few peripheral yellow dots in fundus. Media clear. O. D., many posterior synechiæ. Lower half of cornea hazy and stippled with deposits on Descemet's membrane. Good reflex. No details of fundus. Under atropin, the left pupil dilated fully. December 11th: V. O. S. = 20/40. One adhesion in keratitis punctata. Atropin was prescribed. In right eye the center of the cornea stains. December 12th: Tension 37 both eyes.

CASE 10.—*Uveitis with Glaucoma.*—D. R., aged thirty-three years, was seen April 17, 1911. In December, 1910, he was shot in the right eye with bird-shot, and the eye was removed by Dr. Rightor, of Helena, Ark. He complained of some pain in the left eye. The patient was a particularly robust man, a plantation manager, in fine health and of good habits. V. O. S. = 20/20; improved by sph. + 0.50 ⊂ cyl. + 0.25 ax. 45°. Reads J1. Ophthalmoscopic examination normal. He wore an artificial eye (right) which gave no trouble. March 22, 1912, left eye sore three days. Pupil dilated from atropin. V. = 20/30; keratitis punctata. The attack subsided in six days. December 27, 1912: Vision of left eye a little blurred for two weeks; sees 20/25, not improved. Cornea and aqueous slightly cloudy. Many spots of deposit on anterior capsule. Iris active; fundus very dim. He was examined by a syphilographer who excluded syphilis. Radiogram of right orbit showed a shot at apex of orbit, possibly in the optic foramen. Its removal was advised and declined.

January 23, 1914, patient wrote that eye was well. March 13, 1914. One month ago the eye was sore and atropin instilled. Since then the pupil has been dilated. V = 20/100 +, sph. + 0.50 ⊂ cyl. − 0.50 ax. 135° = 20/40. Pigment deposits on capsule. Nerve cupped. Tension 60*mm*. Field contracted nasally. Eserin contracted the pupil and reduced the tension to 50*mm*. March 14th: Tension 47*mm*; March 19th: Tension (fingers) is down. V. = 20/25; March 20th: Tension 52*mm*; V. = 20/100 sph. − 1.50 = 20/25; March 30th: V. = 20/40 cyl. − 0.50 ax. 135° = 20/30; tension 60*mm*, but feels normal to touch; fundus same; March 31st: Tension 60*mm*, taken with two tonometers; April 21st: Marked iritis, paracentesis corneæ; April 22d: Tension

reduced; vision reduced; April 23d: Ether, upward iridectomy; May 4th: V. = 6/200; tension 57*mm*; much pigment on capsule, but atropin dilated the pupil; fundus seen; eserin ordered; May 5th: V. = 20/200; May 6th: V. = 10/200; tension 57; May 7th: V. = 10/200; tension 57; May 9th: V. = 14/200 sph. −2 = 20/100; May 21st: Sclerectomy (Lagrange) with local anæsthesia; May 26th: Wound pouts considerably; June 8th: Tension 32*mm*; V. = 2/100. Atropin is being used; but much deposit has formed on lens capsule; July 1st: Wound flat; V. = 3/200; tension 28*mm*; much organized exudate in pupil and coloboma; July 24th: O. S. = 1/200; tension 37*mm*; July 25th: Buttonhole iridectomy down and in, the pupil and coloboma being filled with exudate; July 30th: V. = 4/200; tension 32*mm*; August 6th: Tension 42*mm*; V. = 3/200; August 19th; Eye red and painful; tension 17–20*mm*; V. = moving objects; September 9th: V. = shadows; tension 28; lens and capsule opaque; October 4th: Iridocyclitis persists.

March 7, 1915, a letter from Dr. Rightor says the eye is very soft and shrinking. No infection. No inflammation. Vision = p. l.

Case 11.—*Uveitis with Glaucoma.*—Mrs. A. B. W., aged fifty-three years. October 25, 1913, noticed a black spot before right eye, and on reading objects looked blurred. V. O. D. cyl. −0.50 ax. 180°; = 20/20; O. S. = 20/20 cyl. + 50 ax. 90° = 20/20.

The right eye showed a few fine vitreous opacities; the left one fixed one on the posterior lens capsule, in from the center. She was under my treatment for six months, during which time the opacities became more noticeable, but vision remained the same. She was given various forms of alterative treatment, sweats, galvanism, and mercury. Her physician could find no constitutional disturbance. In June, 1914, she returned from a visit to Texas. I had seen her on March 7th and noted vision of 20/25; vitreous not quite clear. On March 16th she consulted Dr. J. S. Steele, of San Antonio, who found V. = 15/100, and some posterior synechiæ which he was unable to break up, some pericorneal injection, and he thought the tension was increased. A Wassermann was negative, but she received four doses of neosalvarsan and iodids, and the pericorneal injection disappeared. He did not mention any local treatment.

On June 14th there were posterior synechiæ, and the tension was 63*mm* right eye, and 52*mm* left. V. O. D. = 15/100; O. S. = 20/25. The fields are as shown. Blood-pressure 145. Under eserin and massage the vision rose to 20/40 right eye, and the tension remained about the same.

On July 10th sclerocorneal trephining of right eye. A peripheral opening in iris was made, as the adhesions prevented drawing out the iris to make a complete iridectomy. July 27th: Tension 24*mm* in each eye. V. O. D. = 20/40; O. S. = 20/20. The field in the right eye was very small. The vision in this eye gradually failed, and the tension slowly rose until in March, 1915, the former was p. l. and the latter was 52*mm*. April 5, 1915: Lagrange operation, right eye, with complete iridectomy. The operation was perfect surgically, except a mass of pigment was left on the capsule where the coloboma joins the pupil. The tension was reduced. In November, 1916, it was 35 (McLean). The eye is blind, but painless.

The left eye has shown variable tension, from normal to 52*mm* (Gradle). The vision is normal, but the fields show contraction, as shown on the chart. There has been one mild attack of iritis in February, 1915, since which myotics have been used once a day. The nerve is moderately gray and slightly but distinctly cupped.

CASE 12.—*Uveitis with Temporary Hypertonus.*—W. E. C. aged twenty-two years, was seen February 24, 1917, complaining of blurring of the vision in left eye for four days. V. = 10/200. There was marked ciliary injection, cornea and aqueous cloudy, pupil slightly dilated and fixed. Tension undoubtedly elevated. The fundus was dimly seen. The eye was tender, and the tonometer was not used, but two observers agreed as to the increase of tension. The pupil was dilated with atropin, when the tension decreased and the eye felt better. Keratitis punctata was then discernible, and a fresh choroidal exudate 2 disk diameters wide and 4 disk diameters above the disk could be seen. In three days vision was 20/80. Atropin discontinued on March 13th. On March 30th: V = 20/20. The general examination showed a negative Wassermann and incipient tuberculosis. No specific medication was used, but such general treatment as his physician deemed necessary, with the addition of alteratives.

REPORT OF THE TRANSACTIONS OF THE OPHTHALMOLOGICAL SECTION OF THE ROYAL SOCIETY OF MEDICINE

By Mr. H. DICKINSON, London.

The ordinary meeting of this Section was held in London on June 13th, Mr. W. Lang, F.R.C.S., President, in the Chair.

The President made sympathetic reference to the death of Mr. Walter Jessop, who was acting as Honorary Librarian to the Bowman Library. To that Library Mrs. Jessop had bequeathed her husband's collection of books.

The Section then discussed **the Ætiology and treatment of iritis.**

The President, in opening, pointed out how desirable it was to arrive at some agreement as to the causes of iritis. The authorities could then be advised as to measures directed to the prevention of much ill-health, and a great amount of loss of sight. In an analysis of 200 cases of iritis in his practice, he found that the causes and their percentages were as follows: syphilis 6%; gonorrhea 12%; tubercle 11%; general affections 8.5%: other causes 25.5%; pyorrhea 37%. Hospital figures would probably show a higher proportion for syphilis than 6%, though recent methods of treating that disease would probably place that disease lowest in the causes. The percentage for gonorrhea was also probably low compared with hospital statistics, but recent knowledge of that disease, resulting in the treatment of the genito-urinary system, where the gonococcus was so apt to lurk, would largely prevent gonococcal iritis. Relapses in cases of iritis seemed to be largely due to pyorrhea. In his series, the sexes were equally affected where tubercle was the cause. Tubercular iritis cases should be

treated on the same lines as subjects of tubercle elsewhere, *plus* local measures to subdue inflammation and prevent closure of the pupil. In 17 of the cases the patient had either gout, or diabetes, or herpes of fifth nerve, or influenza, or pneumonia. Ten had a septic focus on the skin or a mucous surface or cavity. Six had disease of tonsils, 23 some affection of the alimentary tract, and 7 had trouble in the genito-urinary system. In one patient the iritis followed a smart blow on the eye, and another had iritis as a sequel of sympathetic ophthalmia. In 74 of the 200 patients there was no discoverable cause except pyorrhea. Removal of the defective teeth or stumps was followed by a rapid clearing up of the iritis. In 22 other cases pyorrhea existed as a complication of other conditions. Of the 74 cases with pyorrhea alone, the women were twice as numerous as the men. As 48% of the patients had septic mouths, the practical aid of the dental profession would be of great value.

Sir ANDERSON CRITCHETT, Bart., said he had found great benefit from the use of sulphate of duboisine as a powerful mydriatic in cases in which the synechiæ could not be broken down by atropine. This was the suggestion of Sir John Tweed forty years ago. Two grains to the ounce was the greatest strength which should be employed, and care must be taken that none went via the duct into the throat, because of its toxic effects. For acute cases he believed in the use of leeches. For thirty years he had done iridectomy for chronic cases of iritis, as a valuable measure against recurrent attacks. To ensure the perfect quiescence of the patient, he gave a general anæsthetic before doing the operation. In most cases it was necessary to go almost to the pupillary margin, withdrawing very gently.

Mr. J. G. TURNER spoke as an odontologist, and gave an account of his work with the late Dr. John Griffith, in tracing the connection between dental sepsis and eye diseases. They found that when every defective tooth and stump in a patient's mouth was cleared out, a co-existing corneal ulceration quickly cleared up. Practically all were now agreed that iritis was due to a living germ or its toxin, very seldom to the continuity of diseased tissue. The obvious duty was to search for the commonest seat and source of infection, and

this certainly was the mouth, though some nasal surgeons claimed it was the nose. When the periodontal sulcus was invaded, it represented a practically undrainable area of sepsis. The eating of sticky food was responsible for many niduses of germs around the tooth neck. Ulcerations occurring on the toothward side of the gum were not necessarily acute, but they were permanent, always discharging and always absorbing. It was easy for the sepsis from the inflamed gum margins to get into the systemic circulation. A thick pad of apparently healthy gum between teeth should be regarded as suspect. Dead teeth were always septic: in a very large series examined no exception was found to this truth. When the tooth died, the fibrils died also, and nothing had been found capable of penetrating these fibrils for cleansing purposes. Two suggestions he offered were, the teaching of school children how to clean their teeth by nurses who had been specially instructed by dental surgeons, and the avoidance of sticky sugary foods.

Dr. LYON SMITH referred to his eight years' study of arthritis conditions by means of vitiated blood states. For a long time he had the refraction of every arthritic patient who came to him tested by an expert, as he believed strain or trauma determined the seat of arthritic manifestation. In the 450 blood examinations he made, the commonest organisms found were those of influenza, tubercle, gonorrhea, and streptococci, staphylococci, and B. pyocyaneus. The latter was a very common inhabitant of the alimentary canal. He had seen many cases of iritis cured by general inoculations, but very minute doses should be used, a precaution which was justified by the recent researches in colloid chemistry.

Captain A. W. ORMOND argued that if iritis was so closely connected, causally, with pyorrhea, it should be very much more common than was the case. He doubted whether acute rheumatism ever caused iritis. He regarded iritis as always the result of sepsis: he did not think it possible that eye-strain or errors of refraction could cause it. He believed the life-history of the gonococcus in the tissues was too short to account for late cases due to that cause.

Mr. ERNEST CLARKE agreed with Dr. Lyon Smith's remarks as to strain deciding the site of inflammation. By

correction of errors of refraction he had prevented many recurrences of iritis, and rendered unnecessary iridectomy.

Dr. LAKIN said he could not remember an instance of a toxic case being associated with a local outpouring of inflammatory fluid. In iritis the part was vascularized, and an exudate was present. He strongly supported the idea that iritis was microbial in origin, and an embolic process was also at work: the organisms were carried in minute emboli and laid down in the iris. At the junction of iris and ciliary body there was an abrupt change from a highly vascularized to a comparatively avascular system, and in the latter, owing to the diminished supply of oxygen, organisms found an easy resting-place, and were able to multiply. This was a great factor in the production of iritis. Mild iritis he considered was due to a mild form of infection, which did not attract attention until there was a gradual failure of vision.

Mr. LESLIE PATON gave an account of a case which was under his observation, in which proof was afforded of the direct connection between a foul stump and the eye affection. There were iritic adhesions, and a hypopyon. From both the onyx and the stump, staphylococcus aureus and micrococcus tetragenus were recovered, after every precaution had been taken against error or contamination in the investigation.

The various points raised were replied to by the President.

REPORT OF THE PROCEEDINGS OF THE SECTION ON OPHTHALMOLOGY OF THE NEW YORK ACADEMY OF MEDICINE.

By LEWIS W. CRIGLER, M.D., Secretary.

MONDAY EVENING, MAY 21, 1917. GEORGE H. BELL, M.D., CHAIRMAN.

Dr. J. M. WHEELER presented a patient 40 years of age who had lost his left eye five years previously. He was first seen two months ago on account of loss of vision in his right eye. Fundus examination revealed an **intraocular growth.** Wassermann test of the blood was ++++ positive. The patient was immediately put on specific medication and continued to the point of tolerance. Vision which was $\frac{10}{100}$ at the beginning of treatment has failed slightly. The Wassermann test is now negative. Dr. Wheeler says that there are still no evidences of metastases, and wants to know what is the best course to pursue in the case.

DISCUSSION: Dr. BELL suggests that applications of radium be tried. Dr. KNAPP said that he had not had any experience with radium in choroidal sarcoma, but that it had been tried in cases of glioma of the retina.

Dr. ARTHUR S. TENNER presented a case of **monocular optic neuritis following pneumonia.** Mrs. G., age 28, on day following onset of pneumonia, aborted. Two weeks later she noticed dimness of vision in her *left* eye. The eye was painful and the pupil was dilated. Dr. Tenner saw her four weeks after the onset of her eye trouble. At that time her vision was reduced to $\frac{1}{200}$; there was a large absolute central scotoma, and her field of vision was slightly contracted below and nasally. Fundus examination revealed a blurring of the disk margins and the veins were dilated. At the end of six weeks

recovery was complete, except for a slight contraction of her color fields and pallor of the nerve head.

DISCUSSION: Dr. BELL asked if an X-ray of the patient's sinuses had been taken.

Dr. SCHOENBERG asked if the spinal fluid had been examined and tested for a Wassermann reaction.

Dr. TENNER said that the patient's recovery rendered the above tests of little value, hence he had not done them.

Dr. TENNER also presented a patient upon whom he had operated for the relief of a **convergent squint due to congenital paralysis of the external rectus.** He followed the method of Hummelsheim, who had reported two successful cases. A long curved incision was made in the conjunctiva, exposing the insertions of the superior, external, and inferior recti muscles. The outer half of both the superior and inferior recti muscles were severed from their attachments, and the fibers of the divided portion divided from the rest of the muscle to the extent of 10*mm* towards their origin. These loose ends were then stretched across and attached to the eyeball a little in advance of the insertion of the external rectus. Reaction following the operation was severe. Outward rotation was slightly improved. Dr. Tenner does not think the result obtained in this case justifies the procedure.

DISCUSSION: Dr. KNAPP asked if there was any difficulty in attaching the divided portion of the muscles to their new insertions. Dr. TYSON asked if there was any retraction of the globe when the operation was finished. Dr. TENNER answered No to both of the above questions.

Dr. ARTHUR S. TENNER also presented a case of **hypophyseal disease** that had been successfully operated on by Dr. Harvey Cushing with restoration of vision. Dr. Tenner first saw the patient on February 28, 1917. Vision in right eye was hand movements in upper nasal quadrant; in left $\frac{20}{70}$, but fields very much contracted. There was slight enlargement of the thyroid. Before operation by Dr. Cushing on March 30th vision in patient's left eye was reduced to $\frac{20}{80}$. "The pituitary body was exposed by a transfrontal osteoplastic opening. A soft reddish mass was exposed protruding between the legs of the chiasm. An incision was made into this mass and a fairly extensive exploration of the contents was made. There was no

special bleeding and the pocket, which possibly measured 2*cm* in its diameters, was fixed with pledgets of cotton wet in Zenker's solution. The bone flap was then replaced and the wound closed as usual in layers." Seven weeks after operation vision in right eye was $\frac{20}{30}$; left, $\frac{20}{15}$, and fields in both eyes practically normal.

Dr. M. J. SCHOENBERG read a paper on the **intraspinal and intracranial treatment of luetic manifestations of the optic pathways.** He said that the object of the paper was to bring forth suggestions regarding the possibilities of a step forward in the treatment of luetic affections of the visual pathways, and in order to intelligently discuss the subject it was necessary to review our present-day conceptions of syphilis of the entire nervous system, derived from four principal sources:

1. Clinical and laboratory study.
2. Pathological study.
3. The study of the causative agent.
4. The experimental reproduction of cerebrospinal lues in animals.

I.

The causative agent and experimental lues nervosa. A summary of the evidence (pathological and experimental) proving that the spirochætas are the causative agent of cerebrospinal lues and metalues.

II.

A discussion of the question: **"Why does syphilis have a predilection for the nervous system and optic pathways in a certain percentage of cases?"** A review of the three theories: (1) A special strain of spirochæta with neurotrophic and neurotoxic properties; (2) a predisposition of the nervous system and optic paths for the localization of the syphilitic infection; (3) the eclectic or conciliation of both preceding theories.

III.

Can the study of pathology throw some light upon the question: **"Why do some patients get lues and others**

metalues of the central nervous system and optic pathways ?" The modern classification: Interstitial, parenchymatous, and mixed types of lues in the central nervous system and optic nerves. Our inability to answer the question. The experimental method, a way of approaching the problem.

IV.

Therapeutic problems and suggestions.

(A) Our therapeutic success depends on the accurate knowledge of several factors:

(1) The changes in the virulency of the spirochætas and in the biologic properties of the nervous tissue containing them for various periods of time, as one of the factors deciding the response to treatment.

(2) The localization of the microörganisms in places more or less inaccessible to medication or to the natural defending substances.

(3) The mode of action of anti-luetic drugs.

(4) The tissue reaction to the presence of spirochætas and to our medication, natural and artificial stimulation of the defensive and offensive mechanism.

(5) Methods of administration: The intravenous, spinal, and cranial routes.

(B) A few general principles regarding the treatment and diagnosis of lues and metalues of the cerebrospinal system and of the optic pathways.

V.

A brief communication of the author's own cases of optic atrophy treated by intraspinal and intracranial medication.

DISCUSSION: Dr. CONRAD BERENS, Jr., said that he had had no experience with the intracranial treatment of lues. He had, however, had considerable experience in the treatment of cerebrospinal lues by means of intraspinal injections of salvarsanized serum. He said that in several cases in which mercury had been given over a period of years the optic atrophy was progressive and the spinal fluid was still positive. He said that the serum rapidly reduces the number of cells and occasionally the amount of globulin in the spinal fluid, and

has seemed to hold the vision in cases that had been steadily diminishing under the influence of mercury alone.

Dr. Berens said that he had repeatedly noticed an enlargement of the blind spot in cases of optic atrophy before there was any other manifestation affecting the optic nerves, also in certain cases he had noticed a diminution of a previously enlarged blind spot following the administration of salvarsan intravenously. He thought that it would be a good idea to look for this enlargement of the blind spot in all luetic cases in order that optic atrophy might be combated in its very incipiency.

Dr. ISADORE ROSEN said that, if we are to succeed in preventing our cases from reaching the stage in which optic atrophy is so common, lumbar puncture and a complete examination of the spinal fluid is necessary in all cases. He thinks it impossible to prevent cerebrospinal symptoms in spite of the most vigorous internal and intravenous treatment, in some cases, and it is for this reason that a knowledge of the condition of the spinal fluid is so necessary, in order that those cases whose spinal fluid still shows the presence of the disease might have the benefit of the *intraspinal treatment.*

In regard to the *intracranial treatment,* he said that he had had no experience but considered it worthy of a fair trial in the hands of experienced men in view of the fact that our known procedures at the present time in the treatment of the more or less advanced optic atrophies leave much to be desired.

Dr. Rosen said that from serological examinations made at the Vanderbilt Clinic of cases of optic atrophy, there was one class with negative findings in the spinal fluid and another with positive findings of varying intensity. The first class presented no indication for either intraspinal or intracranial treatment; the second class demanded intravenous and intraspinal treatment. In this latter category are found the optic atrophies with tabes, taboparesis, paresis, and the type which is unaccompanied by any other symptoms referable to the central nervous system. In many of these cases the differential diagnosis can be made only by means of the colloidal gold test. Those which are or would ultimately become taboparesis, or paresis, give the typical paretic curve, while those which are combined with the purely tabetic syndrome or have the lesion

localized in the optic tracts, give a luetic curve. The prognosis in the case of the latter findings is obviously better than in the former.

Dr. J. G. DWYER presented a specimen of **filaria loa** removed from the conjunctiva of a man recently returned from the tropics.

REPORT ON THE PROGRESS OF OPHTHALMOLOGY. GERMAN REPORT FOR THE SECOND QUARTER OF 1916.

By H. KOELLNER, Berlin; W. KRAUSS, Marburg; R. KÜMMELL, Erlangen; W. LOEHLEIN, Greifswald; H. MEYER, Brandenburg; W. NICOLAI, Berlin; H. PAGENSTECHER, Strassburg; K. WESSELY, Würzburg; and M. WOLFRUM, Leipsic, with the Assistance of Drs. ALLING, New Haven; CALDERARO, Rome; CAUSÉ, Mayence; CURRAN, Kansas City; DANIS, Brussels; GILBERT, Munich; GROENHOLM, Helsingfors; v. POPPEN, Petrograd; TREUTLER, Dresden; and VISSER, Amsterdam.

Edited by MATTHIAS LANCKTON FOSTER, M.D., F.A.C.S., New Rochelle, N. Y.

I.—GENERAL OPHTHALMIC LITERATURE.

1. KRUECKMANN. **Determination of fitness for military service.** *Verh. d. Heidelberger Ophthalm. Gesellschaft*, 1916.
2. ZIEMSSEN. **Efficiency of ophthalmic surgeons in one army in the present war.** *Ibid.*, 1916.

ZIEMSSEN (2, **Efficiency of ophthalmic surgeons in one army in the present war**) sketches the duties of ophthalmic surgeons in the field, the regulation of the ophthalmic care of troops on the field and on the march, and the injuries and diseases which occur in war, based on experience in one army. In military movements it is not feasible to undertake the special treatment of all wounded eyes close behind the front, though since the spring of 1915 ophthalmic sections have been placed in the field hospitals and sanitary companies, one section to each division, and one in a field hospital for the marching troops, where they have done good service. Their personnel needs to be equalized by an even distribution of the specialists. These special sections have

proved of great value in the many new problems which, like the length of the war, were not foreseen, in the increased need for the prescription of glasses, especially for new levies for the field, and in the retention in the field of men in any way useful. Improvement in transportation has made certain that the carriage of those wounded in the eye from the front to the ophthalmic section will take only a few hours. The activity of the section varies with the need. Ziemssen describes in detail the accommodations, nursing, personnel, equipment with instruments, illumination, etc., as well as the possibilities for examination and treatment at the surgeon's disposal. A very large part of the ophthalmic surgeon's duties consists of the prescription of glasses, for which every means is afforded that they may be quickly and correctly fitted. Another duty is the care of those with wounded or diseased eyes, for the examination and treatment of which the equipment is as near perfect as possible. Among the instruments in use are the perimeter, adaptometer, giant magnet, apparatus for stereoscopic work, and X-ray machines. The X-ray apparatus furnished the army is such that it can be used by the ophthalmic surgeons. The eye section of the field hospital has a rather more complete equipment for its clinical work than the others. Consultations with surgeons, internists, otologists, and dentists can be obtained at any time. The reserve of all articles of outfit and of sanitary material goes through the Etappen-Sanitaetsdepot.

In the second part are described the injuries and diseases of the eye which are met with most frequently close behind the front. First aid in injuries may be confined to a toilet of the wound according to surgical principles, or may consist of removal of the eyeball, when it is destroyed and can by no possibility be saved. Exenteration is preferred to enucleation in the field. Larger wounds, involving the bones of the orbit and of the jaw, are sent to the base hospital as soon as they are able to be transported. Shot wounds of the eye and skull are kept, because they do not bear transportation well. Hand in hand work with surgeons is necessary. For the X-ray examination in the field pictures in three planes with simple marking suffice; a complicated apparatus is out of place. Diseases of the eye form a small percentage of the diseases met with. Trachoma

is completely excluded. The writer is opposed to the idea that there is a special war hemeralopia, and especially to the attempt to blame nutrition as its cause, and believes it to be a baseless alarm. In ordering glasses simple rather than combined lenses should be prescribed.

K.

KRUECKMANN (1 **Determination of fitness for military service**) alludes but briefly to errors of refraction. He considers the dioptric limits of myopia and hypermetropia that render a man unfit for service to be high. Many astigmatics are fitted with glasses and so made fit. Tests of color vision seem to be without object among air men. Tests of the light sense are of much practical utility with hemeralopes. Tests of the visual field are rarely needed, but sometimes are of great importance for the passing of judgment on military duties. Among the one eyed were many officers who were not prevented by their loss from resuming their old duties. Diseases of the lacrimal sac and slight deformities of the lids appear to be unimportant, as they are easily remedied. Conjunctival scars due to a past trachoma form no bar to enlistment. Eczematous and herpetic forms of keratitis are embarrassing to the service on account of their after effects. Interstitial keratitis takes too long for its final healing. The same is true of the rheumatic forms of iritis. Persons with glaucoma are out of question. Slight opacities of the lens and aphakia coexist in many cases with capacity for employment, even on the firing line. Vitreous opacities are hazardous for the military service. Healed foci in the peripheral parts of the choroid do not disqualify a man for enrollment, while on the contrary retinal and optic-nerve diseases do, with very few exceptions. Persons having strabismus with the least vision and without diplopia can be of use. Those suffering from nystagmus are excluded from military service on account of the fundamental disease, of the apparent movements of objects, and of amblyopia, while miners' nystagmus, when it appears only in the dark and when the eyes are directed upwards, does not interfere with the demands of service.

K.

II.—RELATIONS OF OPHTHALMIC TO GENERAL DISEASES AND POISONS.

3. GILBERT, W. **Eye affections in typhoid and paratyphoid fevers.** *Muenchener med. Wochenschrift*, 1916, No. 22, p. 806.

4. HEGNER, A., and ZANGE, J. **Concerning the translabyrinthine operation for tumors in the angle between the cerebellum and the pons, together with a contribution to the operative treatment of cerebral disturbances of vision.** *Klinische Monatsbl. f. Augenheilkunde*, 1916, i., p. 176.

5. LEHMANN, K. **Febris uveoparotidea** (Heerfordt). *Ibid.*, i., p. 302.

6. MUSCHALLIK, E. **Eye symptoms in idiocy.** *Inaug. Diss.*, Breslau, 1913.

7. PINCSOHN, G. **Visual disturbances after the administration of optochin.** *Berliner klinische Wochenschrift*, 1916, No. 18, p. 476.

8. POLLNOW. **Acute optochin intoxication.** *Deutsche medicinische Wochenschrift*, 1916, No. 18, p. 557.

9. VALETTAS, A. **Ophthalmoscopic changes in leprosy.** *Klinische Monatsbl. f. Augenheilkunde*, 1916, i., p. 472.

10. WESSELY. **Eye changes in general diseases in the field.** *Ophthalm. Gesellsch. in Heidelberg*, July 31 and August 1, 1916.

According to Gilbert (3, **Eye affections in typhoid and paratyphoid fevers**), patients with these diseases complain quite frequently of pain in the eyes and brows. In a number of cases he saw this supraorbital neuralgia also after the first and the second inoculation for typhoid, in which it was usually bilateral and lasted as much as eight days. In addition he met with two cases of metastatic iridocyclitis in the course of a paratyphoid, appearing toward the end of the second week and in the third week of the disease, at the beginning of convalescence. In one case the iritis appeared simultaneously with a roseola on the body. In both the endogenous infection of the uveal tract began as a conjunctivitis with little secretion and showed the typical picture of a superficial iritis, with active exudation into the anterior chamber and without circumscribed foci of inflammation.

MUSCHALLIK (6, **Eye symptoms in idiocy**) found the following conditions in eighty-seven cases of idiocy which presented ocular troubles. Strabismus in 41.3%, nystagmus in 30%, simple optic atrophy in 21.8%, disturbances of the pupillary reactions in 10%, lenticular opacities in 8%, immobility of the pupil, luxation of the lens and ectopia, zonular cataract,

choroiditis, pallor of the papilla, and ptosis in 3.4%, coloboma of the iris and choroid and neuritis in 2.3%, eccentric pupil, persistent pupillary membrane, chorioretinitis, choked disk, and neuritic atrophy in 1.1%. The movements of the eye were limited in two cases; one had paralysis of the abducens, anomalies of the color sense, deep-seated eyeball, myopia of twenty dioptres, and contraction of the visual field. The occipital lobes were preeminently involved when the optic nerves were affected. Nineteen of the eighty-seven cases were familial, divided among seven families.

VALETTAS (9, **Ophthalmoscopic changes in leprosy**) found that by digital pressure he was able to see upon and in front of the ora serrata in its temporal portion round, white, slightly lustrous spots as large as the head of a pin on a gray-black background, while the nasal side was normal. He thinks, after seeing this in two cases, that it is a fairly early change in leprous eyes, because it occurred simultaneously with superficial keratitis and the commencement of episcleritis, and that it is an infiltration with fatty or lipoid degenerated leprosy cells. Its early localization in the ora serrata and its absence in the rest of the retina he ascribes to the inhibiting influence of light upon the leprosy cells, which may also explain why the temporal side alone was affected as the nasal portion which remained normal is readily reached by light. The superficial punctate keratitis that developed simultaneously appeared in the parts of the cornea covered by the upper lid.

The cases collected by Lehmann (5, **Febris uveoparotidea**) developed after slight prodromal symptoms a bilateral uveitis and chronic parotitis with a low continued fever. In over half of the cases there was a peripheral facial paresis, either on one or both sides. In addition to the parotid the lacrimal and the other salivary glands frequently are involved, as well as several of the larger groups of lymphatic glands. Usually there was a chronic iridocyclitis with a formation of nodules in the iris, which vary in color from yellow to brown red, frequently are gray, and resemble frog spawn. The histological examination of one of these nodules, as well as that of a cervical lymphatic gland, revealed tuberculosis, which, together with

the clinical course, leads the author to believe this to be an atypical form of this disease. The affection of the lymphatic glands passed away leaving no trace, but that of the eyes led to serious impairment, often to blindness.

HEGNER and ZANGE (4, **Translabyrinthine operation for tumors in the cerebello-pontine angle**) consider the dangers of Krause's method too great, as the mortality is between sixty and eighty per cent. They think that this method, with its broad opening of the skull, should be restricted to those cases in which it is indispensable on account of the situation and extent of the tumor, while for the relatively small and frequently extradural true tumors of the auditory nerve the translabyrinthine approach is preferable. They report the successful removal in this manner of a tumor of the acoustic nerve as large as a hen's egg, which was both extradural and intradural. The 22-years-old patient had noticed for a year occasional obscurations of both eyes with a slight feeling of dizziness on stooping and deafness of the right ear. For four months there had been a constant veil before the eyes. Examination revealed choked disks and a marked contraction of the field in both eyes, nystagmus on looking far to the left, total deafness of the right ear, areflexia of the right cornea, disturbance of taste on the right anterior half of the tongue, cerebellar staggering in walking, complete absence of excitability in the right vestibular apparatus. These symptoms pointed to a fairly large tumor in the cerebello-pontine angle. At the operation the petrous portion of the temporal bone was chiselled away step by step. In the internal auditory canal was found a tumor as large as a cherry pit, which embraced the facial nerve and was firmly attached to the dura. After further chiseling away of the bone and division of the cerebellar dura, a tumor about as large as a hen's egg, which had partially displaced the cerebellum, was shelled from the angle with the finger. A loose iodoform tamponade was applied. At the end of twenty-four hours there was a serious collapse that called for immediate loosening of the tampon and artificial respiration. Recovery at the end of six weeks. The right facial nerve was torn away during the operation, and this resulted in a postoperative neuroparalytic ulcer

of the cornea. The advantages of the operation are: The dura of the cerebellum is laid bare very slowly and sudden fluctuations of pressure are thereby avoided; the course of the operation is extradural, so that there is no displacement or crushing of the cerebellum; secondary infection of the soft membranes is avoided; even when the tumor is intradural it can be shelled out without material displacement or crushing of the cerebellum; there is little danger of serious hemorrhage.

WESSELY (10, **Eye changes in general diseases in the field**) deals exhaustively with the forms of iritis met with in typhoid, paratyphoid, and dysentery, which have something in common in their course and mode of origin, from the careful study of which it may be possible to obtain clues to guide to the determination whether they are metastatic or toxic in their ætiology. The occasional appearance of a herpes corneæ (keratitis dendritica) after the protective immunization against typhoid fever may be interpreted as an effect of the bacterial endotoxine, an observation which may open the way later to an experimental investigation of such epithelial diseases of the eye of nervous origin. In typhus fever only occasional changes in the retinal vessels were observed, aside from the characteristic initial injection of the conjunctiva. Cholera showed little worthy of note ophthalmoscopically. In epidemic cerebrospinal meningitis the findings were the same as in times of peace. Catching cold assumes considerable importance as a factor in the metastasis of pathogenic agents latent somewhere in the body, from army experience. Of interest was the onset of severe metastatic conjunctivitis as a prodromal symptom of certain forms of acute articular rheumatism, which were confined to certain regions and certain times. In general sepsis, metastatic ophthalmia was observed more often than is usual in the so-called surgical sepsis, but on the whole the number of cases does not appear to be large. The war nephritis, which as a very acute glomerulonephritis setting in with œdema frequently led to uræmia, not rarely induced uræmic amaurosis, but as a rule this passed off without permanent injury. At the acme of the nephritis one can often see a swelling of the papilla, an œdema of the surrounding retina, and venous engorgement, conditions which lead one

again to consider Traube's mechanical theory of the origin of uræmia. A slight obscuration of the papilla and minute sheathings of the vessels may frequently be found later in such cases as permanent traces. The theory that retinitis albuminurica does not occur in war nephritis, and that its appearance is of differential value as indicating a recurrence of a former nephritis, was not confirmed by the observations of the writer. When one can watch the cases for a sufficient length of time he finds in about 3% of the entire number a typical albuminuric retinitis, always in persons whose blood pressure has been high for a long time. Conjunctival, exceptionally orbital, hemorrhages often occur in Weil's disease. Experiences with regard to tuberculosis and syphilis do not differ from those of times of peace. Conjunctival infections due to gonorrhea were rare, and caused severe blennorrhea only exceptionally. The explanation of this is that persons with fresh gonorrhea come under the care of the physician quickly, and only recurrences of former infections believed to be cured are easily passed unnoticed. As in these cases the gonococci are weakened, the conjunctivitis is very mild at first and gradually increases in virulence. With respect to the eye symptoms caused by conditions of exhaustion, care must be taken, particularly as regards hemeralopia, which seems to him to be a lowered condition of adaptation when one emerges into the light.

K.

Out of thirty cases of pneumonia in which optochin had been given, POLLNOW (8, **Acute optochin intoxication**) saw no after effects in twenty-five, but disturbances of sight and of hearing in five. In two cases there were slight, quickly transient visual disturbances, in one tinnitus of the ears, in two serious troubles in the eye. Both of the last were quite blind at first; one patient later regained approximately normal conditions, but only a very slight improvement was obtained in the other. They received 0.25g of optochin hydrochloride every four hours. In the latter case amaurosis set in on the third day, and gradually began to improve after several days. Now both papillæ are very pale, the vessels tortuous, the arteries very small, some obliterated, some with white sheathings, the retina œdematous over a large area about the papilla, with a red

spot in the fovea. Vision of each eye, fingers at from 1 to 1½ meters. Visual field concentrically contracted to a high degree. Blue and red are the only colors recognized of large objects. Diagnosis: neuritic atrophy secondary to disease of the optic nerve and retina, with œdema and vascular disease. In the other case the symptoms and the changes in the fundus are similar, but the vision has improved to ¼. It appeared to the writer to be a typical quinine poisoning, in which probably circulatory disturbances play the chief part. On account of the greatly varying individual susceptibility to quinine, optochin should be given in very careful dosage.

PINCSOHN (7, **Visual disturbances after the administration of optochin**) also has observed injuries of the eyes by optochin hydrochloride. Doses of 0.25*g*, amounting to not more than 1.5*g* a day, are able to cause damage which is not always of a harmless character. They were of a transient nature in the two cases he reported.

III.—GENERAL AND EXPERIMENTAL PATHOLOGY AND TREATMENT

11. HESSE. **Treatment of infectious eye diseases with animal charcoal obtained from blood.** *Muenchener med. Wochenschrift*, 1916, No. 20, p. 707.

12. VON SZILY. **Experiments in anaphylaxis with the so-called chemically pure eye pigment of cattle, swine, and rabbits, together with studies in pathological anatomy.** *Klin. Monatsbl. f. Augenheilk.*, Feb.–March, p. 197.

The experiments of VON SZILY (12, **Experiments in anaphylaxis**) did not confirm those of Elschnig and Salus with reference to the antigen function of the co-called chemically pure pigment of the eye. The fluctuations of temperature in general anaphylaxis experiments with isolated pigment of guinea-pigs could not be interpreted in a positive sense, because a large number of the control animals injected only once reacted with not inconsiderable movements of the temperature. Clear clinical symptoms of another kind, especially anaphylactic death, were observed in no case. Local experiments in anaphylaxis on the eye with the so-called chemically pure eye pigment of rabbits proved absolutely negative. A spon-

taneous flaring up of a subsiding inflammation, after an interval characteristic of anaphylaxis, was not observed. The pathological examination of the eyes in these experiments gave a negative result, in conformity with the observations on the living animals. The anatomical changes caused by reinjection of the same eyes exceeded neither in rapidity of onset nor in severity the changes observed as the result of the first injection. A fact that seems to be of the greatest importance is that inflammations of varying intensity are called forth by the first injection of the same quantity of pigment in the individual animals used for experiment. The changes induced by the second injection manifest themselves by two equally marked inflammations, one behind the other, at the same place, and it is to be considered that the second injection finds a medium greatly changed by the first. Therefore there should be constantly a very markedly greater reaction to the second local injection to indicate a local anaphylaxis, which was not the case. Reinjections in the second eye acted the same as the first injections in animals not treated before; reinjections in the blood current caused no flaring up of a subsided inflammation in the previously treated eye. The inflammatory local reaction proved both clinically and histologically, to be wholly dependent on the quantity of pigment injected, both in the sensitization and the reinjection. A more marked action of the reinjection, which could be interpreted as the expression of anaphylaxis acting through sensitization, was, in contrast with the results of former experiments with serum albumin and tissue extracts, excluded with certainty as regards the so-called chemically pure eye pigment. Further experiments are needed to clear up a disagreement between the experiments of Elschnig and Salus concerning the biological action of the isolated pigment of the eye. The suggestions made on many sides concerning the antigen nature of the so-called chemically pure eye pigment are of special interest. Were the albuminous nature an unconditional assumption for the reactive capacity of materials in biological experiment, the suggestions would be justified and these negative results explained. The determination of the antigen character of a substance does not depend so much on its physico-chemical properties as on its behavior in biological experiments. There

are biologically active principles known which withstand tryptic digestion and give no ordinary albumin reaction. The presence of a specially resistant albumin nucleus in the so-called chemically pure pigment could be imagined, but the question of its antigen nature must be regarded as still open.

HESSE (11, **Treatment of infectious eye diseases with animal charcoal obtained from the blood**) reports four cases of fresh gonorrheal ophthalmia which, aside from cleansing with permanganate solution, were treated only with Merck's preparation of blood charcoal dusted freely into the conjunctival sac. Also three cases of membranous conjunctivitis with gram positive diplococci, and two cases of serpiginous ulcers. In the last the ulcers were covered thickly with the charcoal dust additionally to the use of atropine and heat. All of the cases did surprisingly well.

IV.—METHODS OF EXAMINATION, INSTRUMENTS, AND GENERAL OPERATIVE TECHNIC

13. ADAM. **Protheses for loss of the eye and large defects in the ocular region.** *Ophthalm. Gesellsch. in Heidelberg*, July 31 and August 1, 1916.

14. GREEF, R. **Glasses and protective apparatus for the eye from cellon and triplex glass, military snow, sand, and gas mask glasses.** *Ibid.*

15. KRUSIUS. **Results of suture and covering of the eye after fresh wounds of the eyeball.** *Ibid.*

16. SEIDEL. **Local anæsthesia for the temporary resection of the outer wall of the orbit (Kroenlein's operation).** *Archiv f. Ophthalm.*, xci., p. 294.

Two substances which the war has proved useful in the manufacture of protective glasses are described by GREEF (14, **Glasses from cellon and triplex glass**). The first is cellon, a derivative of cellulose and related to celluloid, which is not inflammable and not affected by acids or acrid gases. It is used in very thin plates in sand glasses, gas masks, airships, etc. The second, triplex glass, consists of two thin plates of plate glass with a layer of cellulose, which prevents wounds of the skin and eye when they are splintered. The official military snow spectacles, which have proved useful, are made of simple smoky gray glass with a lateral wire sieve attachment. Protection against intense light is less needed. Neither euphos nor Hallauer's glass is used officially. Sand

spectacles are quite necessary in sandstorms in Flanders and the Orient. For gas masks plates of cellon are mostly used. A new spectacle for the army was exhibited in which the temples were replaced by movable bands which fasten the spectacles to the ears and do not interfere with the gas masks as the ordinary temples do.

K.

KRUSIUS (15, **Suture and covering of the eye after fresh wounds**) deals with the conjunctival plastic of the cornea, the plastic covering of scleral wounds, and a method of evisceration of the eyeball with preservation of the cornea. The technic of these procedures is described. First group: Plastic covering of the wound in 34 cases in which it appeared to be not infected and free from the presence of a foreign body, 62% wound of the sclera, 30% of the cornea and sclera, 8% of the cornea alone. Immediate result: prevention of infection in 100%. Final results: unirritated seeing eye in 31 of the 34 cases, vision less than $\frac{1}{10}$ in 9, better than $\frac{1}{10}$ in 22; blindness in 3. Later enucleations because of fear of sympathetic ophthalmia, 4. This group contains 27 successful extractions of splinters, 3 of brass or copper and 24 of iron. Second group: Thirteen cases of plastic covering of wounded eyes still able to see, but either infected or containing foreign bodies, 7 scleral, 5 corneo-scleral, 1 corneal. Immediate results: inhibition or prevention of infection in 12; one eye had to be eviscerated because of panophthalmitis. Final results: persistent signs of irritation in 8, absence of irritation in 4, with preservation of vision, 1 with a splinter of brass, 3 with particles of stone. This group consisted of 13 failures to extract foreign bodies, 2 of iron, 6 of copper or brass, 4 of stone, 1 of lead bullet. Taken in connection with group one we find 26 wounds with splinters of iron with attempts at extraction successful in 24, 94%, and unsuccessful in 2, 6%. Third group: Eighteen cases of plastic covering of disorganized, yet not blinded, eyes, with preservation of form, scleral 17%, corneo-scleral 17%, corneal 66%. Immediate results: prevention of infection in 15, panophthalmitis in 3. Final results: evisceration in 17%, unirritated blind stumps in 23%, perception of light in 60%. Fourth group: Ten cases of diascleral evisceration of the contents of the eyeballs which were destroyed

and blind. Final results: non-irritable stumps without danger of sympathetic ophthalmia in all cases.

The immediate results of the plastic operations performed in the above cases are the prevention of an acute late infection, and the rendering of the wounded man fit for transportation. These form an imperative indication for the performance of such operations on freshly wounded eyes, at suitable places, after the splinters have been extracted. Examination with the X-ray and magnet extraction must precede. The time of observation is not sufficient for a positive determination of the final results, but even if these were not as good as indicated it would not form a contraindication to the procedure.

K.

ADAM (13, **Protheses**) recommends the implantation of a piece of fat, taken from the thigh, to form a better stump for a prothesis after enucleation or evisceration of the eyeball. He exhibited a large number of protheses devised for the varying conditions that result from battle wounds, for contracted orbits, for partial or complete loss of the lids, for funnel-shaped cavities in the orbit, for coincident ptosis, and for use in the intervals between plastic operations on the lids. For large defects in the neighborhood of the orbit glycerine-gelatine eyes come into question as well as those of glass, metal, and wood. A plaster cast is made of the large defect, and from this a casting mold is finally formed. Unfortunately these protheses last only a limited time and have to be replaced frequently. K.

After disinfection with tincture of iodine SEIDEL (16, **Local anæsthesia for Kroenlein's operation**) infiltrates the skin with a 1% solution of novocain and adrenalin. Then he introduces the needle at the outer upper angle of the orbit and injects about 5*ccm* of a 4% solution of novocain and adrenalin at various depths. Then he touches the posterior margin of the vertical fronto-sphenoidal process of the malar bone and, holding the needle vertically, passes it from above downwards, about a finger's breadth outwards, from the upper lateral angle of the orbit, to distribute about 6*ccm* of a 1% solution of novocain and adrenalin on the posterior surface of the fronto-sphenoidal process. Then the needle is passed at the outer lower angle of the orbit along the lower orbital

fissure to a depth of 3 or 4*cm*, and 3*ccm* of a 2% solution injected. The operation can be commenced ten minutes later.

V.—ANATOMY, EMBRYOLOGY, MALFORMATIONS.

17. HERRENSCHWAND. **Entropion palpebrarum congenitum.** *Klin. Monatsbl. f. Augenheilkunde*, lvi., p. 509.

18. HERRENSCHWAND. **Congenital bilateral opticociliary veins.** *Ibid.*, p. 504.

19. HERRENSCHWAND. **Ectropion conjunctivæ palpebrarum congenitum.** *Ibid.*, p. 477.

20. VAN DER HOEVE. **Abnormal length of the canaliculi with ankyloblepharon.** *Ibid.*, p. 232.

21. KRUECKMANN. **Lymph passages of the retina.** *Ophthalm. Gesellsch. in Heidelberg*, July 31 and August 1, 1916.

22. PAGENSTECHER. **Effect of X-rays on the growing eye. Experimental studies concerning the origin of retinal rosettes.** *Ibid.*

KRUECKMANN (21, **Lymph passages of the retina**) demonstrated lymph sheaths about the capillaries of the retinal vessels between the endothelium and the membrana limitans gliæ perivascularis.

A case of congenital entropion of both lower lids in a child a year and a half old is described by HERRENSCHWAND (17, **Entropion palpebrarum congenitum**). The anomaly was wholly due to an overdevelopment of the orbicularis palpebrarum at the marginal portion of the lid. The tarsus was perfectly normal. Recurrence soon followed the canthoplasty first performed, but a cure was secured through an excision of the greater part of the muscle of that part of the lid.

The first glance at a case observed by HERRENSCHWAND (19, **Ectropion conjunctivæ palpebrarum congenitum**) gave the impression of an ectropion due to chronic blepharitis, but it proved to be a peculiar congenital anomaly of development of all four lids. The conjunctiva extended out over the edge of the lid, so that the lids appeared to have red edges, the inner edge of the margin appeared to be rounded off, and the closure of the lids was imperfect. In addition there were symmetrical conjunctival cords of adhesion between the corneæ and the lower lids, and the lacrimal puncta were altogether absent. The tarsus was not turned outwards, but on the contrary turned inwards. The lids were shortened.

VAN DER HOEVE (20, **Abnormal length of the canaliculi with**

ankyloblepharon) reports three cases of congenital ankyloblepharon in which, beneath the adherent margins of the lids, the plica semilunaris was normal, but the caruncle much enlarged and firmly adherent to the inner surface of the lids. The lower lacrimal puncta had an anomalous position; they were as far from the newly formed canthus as from the normal one, so they did not dip into the lacrimal lake, but lay in front of the cornea.

HERRENSCHWAND (18, **Congenital bilateral opticociliary veins**) saw in a healthy man 30 years old, in whom conditions otherwise were physiological, two opticociliary veins running in the same direction. The one in the right eye rose from the lower temporal margin of the papilla, while that in the left came from the lower nasal border. Both had the color and reflex streaks of the retinal veins, but were considerably broader than the common venous trunks on the papilla. Pressure upon the eye caused them to become empty of blood much sooner than the rest of the retinal veins. Therefore the writer is inclined to think them venous anastomoses rather than independent veins.

In 1909 Seefelder described a congenital rosette of the retina and thought it connected with the genesis of glioma. Fräulein Lindenfeld in 1913 described similar granular rosettes of the retina in the eyes of a male fetus, the mother of which had been treated with X-rays during her pregnancy to induce sterility, and questioned whether the X-rays were not responsible for the retinal anomaly. PAGENSTECHER (**22, Effect of the X-rays on the growing eye**) has investigated this question and shows that when pregnant rabbits were irradiated typical granular rosettes could afterward be demonstrated in the retina of the living fetus. Hence there is no doubt that the X-rays can induce congenital rosettes of the retina in man and animals.

VI.—PHYSIOLOGY OF NUTRITION AND EYE TENSION.

23. SCHREIBER. **Loss and replacement of vitreous.** *Ophthalm. Gesellsch. in Heidelberg*, 1916.

SCHREIBER (23, **Loss and replacement of the vitreous**) aspirated vitreous from the eyes of rabbits and found that in

a large number repeated aspirations, amounting to as much as 1.4*ccm*, were borne by the eye. A persistent detachment of the retina occurred in only 27% of the cases. In the course of two months he removed from one rabbit's eye 3.9*ccm* of vitreous in five sittings. From the eye of another rabbit he took 1.4 *ccm* twice within three months. Each time the eye refilled in two or three hours, or at most twenty-four hours, so that one could get a fairly good ophthalmoscopic picture, and the intraocular tension became normal within two or three days. The microscopic examination revealed no notable changes in the vitreous, ciliary body, iris, or choroid. The spontaneous replacement of the vitreous took place nearly as quickly as that of the aqueous. Probably it was nothing else than the secretion of the ciliary body, which is identical in its ophthalmoscopic behavior with the original vitreous. Experience has shown that a man's eye possesses to a high degree the capacity for spontaneous replacement after a traumatic or operative loss of vitreous. Therefore the writer urges conservative treatment, with careful aseptic precautions, of eyes that have suffered a large loss of vitreous, and agrees with Knapp in considering the immediate distention of the collapsed eyeball with isotonic salt solution to be unnecessary. Such a procedure is indicated only when the vitreous is not replaced spontaneously.

K.

VII.—THE SENSE OF SIGHT.

24. ABELSDORFF. **Bilateral central scotoma in an otherwise normal visual field after shot wound of the occiput.** *Klin. Monatsbl. f. Augenheilkunde*, lvi., p. 172.

25. BIRCH-HIRSCHFELD. **Hemeralopia in war.** *Ophthalm. Gesellschaft in Heidelberg*, July 31 and August 1, 1916.

26. FLEISCHER. **Concerning the loss or preservation of the temporal crescent of the binocular visual field in only one eye caused by shot wound.** *Ibid.*

27. JESS. **The investigation of hemeralopia at the front.** *Ibid.*

28. LOEHLEIN. **Observations on hemeralopia in the field.** *Ibid.*

29. SEELERT. **Isolated pathological sensory sensation in cerebral syphilis.** *Berliner Gesellschaft f. Psychiatrie u. Nervenkrankh.*, May 8, 1916.

30. STOCK. **Shooting with glasses.** *Ophthalm. Gesellschaft in Heidelberg*, July 31 and August 1, 1916.

31. ZADE. **Blinding in the aviation service.** *Ibid.*

After a wound of the occiput ABELSDORFF (24, **Bilateral central scotoma after shot wound of the occiput**) saw a small, left-sided, hemianopic scotoma appear, which, as the wound healed, increased into a bilateral central scotoma. Otherwise the visual field was normal. The constancy of the answers in the repeated examinations leads it to be supposed that an organic change lay at the base of the functional disturbance. Presumably it affected the right cuneus first, crossed the middle line, and then attacked the left. At any rate the case furnishes new evidence in favor of the theory that there is an insular cortical center for the macula. The normal vision, aside from the central scotoma, was remarkable.

From clinical observations Wilbrand long ago concluded that the nerve fibers which supply the temporal crescent in the visual field pass in a bundle separate from the rest of the optic nerve fibers centrally from the chiasm to the occiput. That these fibers run separately in the occipital lobes also, and have their own area of distribution in the cortex of the occipital lobes, is shown by the observations of FLEISCHER (26, **Loss or preservation of the temporal crescent**) in shot wounds of the occiput. In one case the temporal crescent of one eye was destroyed by a shot lying just beneath the cortex of the lobe, whence it was later removed. In two other cases it was partially preserved, in one after the extraction of a bullet from the occipital lobe, in the other after a shot wound followed by the formation of an abscess. In the latter cases there were traces of the upper quadrant with an intact lower quadrant. The markedly lateral situation of the shot in the first case, with the position of the wound close to the middle line in the last, make it probable that the cortical area of the temporal crescent lies somewhat laterally in the optical field of the occipital lobe.

Reliable investigations of the dark adaptation in hemeralopia are difficult in the advanced eye stations at the front, and simulation is not to be guarded against. JESS (27, **Hemeralopia**) recommends therefore careful examinations of the field of vision, especially of the color fields, as characteristic disturbances here are almost constantly present in true hemeralopia. In order to recognize beginning contractions of the blue yellow limits, in comparison with the red green, it is necessary to note with special care the limit of yellow, as

a contraction of this may be found when one for blue cannot. Of sixty-one soldiers of all arms, who were said to be night blind, thirty-five showed typical disturbances of the visual field which confirmed the diagnosis of hemeralopia. Of the remaining twenty-six, six were so-called dioptric hemeralopes, eighteen showed no disturbance of adaptation on examination with a photoptometer, and only two had a distinct disturbance of adaptation with no anomalies of the visual field. A number of pictures showed the typical displacements of the color boundaries, their enlargement with improvement of the hemeralopia, their greater contraction as the latter became worse, as well as paracentral defects in the form of ring scotomata, of which seven were observed resembling the peripheral scotomata produced by dazzling. Careful investigation of the histories and prolonged observation established the fact that only eight of these cases originated in the field, caused perhaps by nutritive disturbances and weariness, while all of the others were congenital, had developed before the war, or were due to local disease.

LOEHLEIN (28, **Hemeralopia**) assumed at first, like most ophthalmologists, that the frequent occurrence of hemeralopic troubles in war was to be ascribed to the details of nutrition in the field, and thinks that this theory may suffice for many cases at the east front, where the conditions for such an ætiology are favorable. But the theory is not very tenable on the west front. Careful examination shows rather that perhaps half of the cases should not be designated as hemeralopes, on the basis of their previous histories, general examination, and adaptation tests. The visual disturbances among these people come rather from nervous and psychical exhaustion, in which arteriosclerosis, migraine, nicotine poisoning, abuse of alcohol, and neurasthenia are important factors, either singly or together. They impress one as hemeralopic because their visual disturbances place them at a disadvantage particularly during the strenuous and exciting night battles. He considers the only examination demonstrative of a disturbance of the adaptation to dark is one in which the patient is examined at the same time with, and under the same conditions as, a control person with normal adaptation. He also recommends that, aside from fitting the patient with glasses, we bring

the day vision of the control person to that of the patient with plus glasses. Even then the number of hemeralopes in the field is remarkably high. Only occasionally are there among them cases of a freshly developed symptomatic hemeralopia. The overwhelming majority are persons who are less adaptive than normal when they come out of a house, and part of them became conscious of this weakness for the first time under the difficult conditions of night warfare. This theory is supported by the fact that the capacity of adaptation varies greatly in normal eyes, as well as by the statements of these people that they had noticed their mistakes in the first dark nights. The theory that it is due to faulty nutrition is untenable because the hemeralopia is always found only in single individuals from the most various parts of the troops, a change of diet for several weeks causes no improvement, and the persons affected are almost always in a very good state of nutrition.

BIRCH-HIRSCHFELD (25, **Hemeralopia**) gave the results of the examination of 155 soldiers who complained of night blindness. The trouble had appeared in 120 before the war, usually in early youth, and in 35 during the war. Eleven of the latter had been wounded and had lost blood, five had suffered from intestinal troubles, three had been dazzled, one had been poisoned with optochin. The cases were always sporadic, never epidemic. The average age was thirty-four and a half years. The nutritive condition of about half of the cases was poor. Among refractive errors myopia was especially prominent. There were 54 emmetropes, 17 hyperopes, 14 astigmatics, 70 myopes. In 31 the myopia was more than six diopters. Central vision was normal in 69, fair in 67, bad in 19. The ophthalmoscope showed a normal condition in 73, lack of pigment in the fundus in 34, and individual pigment anomalies in 41. The visual field was contracted with reduced illumination, especially for blue, in 121, moderately for white and blue in bright daylight in 36, and to a high degree in 30. The central and peripheral perception of blue was almost regularly disturbed in reduced illumination. Special care was given to the determination of the stimulative threshold and the adaptation, which revealed three kinds of the disturbance: 1, Elevation of the threshold with good adaptation in 33; 2, flat curve of adaptation with a

slightly raised threshold in 17; 3, elevation of the threshold with greatly diminished adaptation in 103. The third type includes particularly the cases with marked disturbances in vision, visual field, and color sense, and presenting retinal changes. Between the three varieties are transition forms and a case may pass from one type into another. Of 54 cases observed for several weeks only ten showed an essential improvement. He does not consider the patients fit for military service if after half an hour's adaptation to dark the sensitiveness is less than one fourth the normal. Only in rare and special cases is the injury to be ascribed to the service. Treatment consists of correction of refractive errors, improvement of the general condition, and protection against dazzling. He thinks night blindness to be a trouble not dependent on any one cause, and that the term war hemeralopia is not suitable. Various factors may take part in its ætiology, some general, some local. Among these may be named hereditary influences, which were present in a third of the cases; myopic changes in the retina and choroid; faulty nutrition, lack of vitamines; debility caused by liver and intestinal troubles or loss of blood; poisoning with optochin, quinine, and perhaps alcohol. Dazzling may perhaps be an exciting factor. Neurasthenic symptoms are not rare, yet it is a mistake to consider the trouble a variety of neurasthenia. The entire symptom complex is not indicative of a psychogenous cause, but points to an organic disturbance of the apparatus connected with the increase of sensibility in the dark.

ZADE (31, **Blinding in the aviation service**) reports 165 cases of ring scotoma met with among the officers and men of the aviation service. The examination is made with a perimeter having a radius of one meter with an object 4*mm* square. The scotoma begins on the temporal side, taking first a crescentic and later a circular form. The ring is often open above The scotomata lie for the most part very peripherally, are small, usually relative, bilateral, and quite rarely two concentric rings may be found in one eye. They were found in about one half of the subjects examined, but the percentage among the airmen is higher, 84%. The cause is dazzling by diffuse light. The earliest onset of the scotoma was three weeks after beginning duty in the air service. Involution is very

probable. No connection with the refraction or the content of pigment was found. Colored protective glasses are recommended, which would at the same time improve the vision of the air man in the heavens.

STOCK (30, **Shooting with glasses**) has studied the questions of the minimum vision needed by the infantryman to enable him to shoot, the direction of the line of vision through the glasses in shooting, and what glasses should be worn. He concludes that the minimum vision for an infantryman is 0.8 of the normal and that the correction must be accurate. An error of half a diopter may render the vision insufficient. While shooting, the soldier looks obliquely through the glass about 12*mm* from its center. Astigmatism must be corrected accurately to within less than .25 of a diopter. Glasses which cause an astigmatism of half a diopter when looked through obliquely are not useful in shooting. The glasses need not only to be correct, but also to be adjusted properly to the face.

SEELERT'S (29, **Isolated pathological sensory sensation in cerebral syphilis**) patient had suffered for three years with cerebrospinal syphilis. At the beginning of the disease he had an attack of derangement of feeling in his right hand, spasm of the lips, and a short, probably motor, aphasic trouble with his speech. During the next year and a half he had several light attacks, always with trouble in speech. Pathological acoustic and optic sensation appeared at Christmas, 1914. He heard music, singing, and shrieks. He seemed to see remembered objects. "I have before my eyes everything I have done in my life." These symptoms were very troublesome and tormenting, but never had in the consciousness of the patient the character of physiological perceptions.

VIII.—REFRACTION AND ACCOMMODATION.

32. LEVINSOHN. **The question of the origin of myopia.** *Zeitschrift f. Augenheilkunde*, XXXV., p. 243.

33. WOLLFBERG. **Disturbance of the perspective by binocular correction with cylindrical glasses.** *Wochenschr. f. Ther. u. Hygiene d. Auges*, No. 25.

LEVINSOHN (32, **Origin of myopia**) holds that the accommodation cannot exert the influence ascribed to it, because it

causes no angulation of the vortex veins, and the pull extends only to the equator, where it ceases. A stretching of the sclera due to bad blood supply would not be confined to the posterior pole, but would extend uniformly over the entire posterior segment of the eye.

WOLLFBERG (33, **Disturbance of the perspective by binocular correction with cylindrical glasses**) reports eight cases of hypermetropic and two of myopic astigmatism in which the correction with cylindrical glasses produced a remarkable disturbance of perspective. With the hypermetropes, objects appeared to be turned backward, with the myopes turned forward. He suggests as an explanation that the astigmatic distortion is corrected psychically when the binocular vision is uncorrected, and that when the correction with glasses is applied the psychical correction is superfluous and renders the appearances incorrect.

IX.—THE MOTOR APPARATUS OF THE EYE.

34. BIELSCHOWSKY. **Disturbances of motility after battle wounds.** *Ophthalm. Gesellschaft in Heidelberg*, July 31 and August 1, 1916.

35. LOEHLEIN. **Psychogenous paresis simulating a bilateral paresis of all of the extrinsic eye muscles.** *Klin. Monatsbl. f. Augenheilk.*, lvi., p. 541.

36. POLLACK. **Latent nystagmus.** *Berliner Gesellschaft f. Psychol. und Nervenkrankheiten*, March 13, 1916.

37. URBANTSCHITSCH. **A case of reflex nystagmus.** *Oesterr. otologische Gesellschaft*, December 10, 1915.

38. WEHRLI. **Six cases of latent nystagmus.** *Klin. Monatsbl. f. Augenheilk.*, lvi., p. 444.

According to BIELSCHOWSKY (34, **Disturbances of motility after wounds**) disturbances of the motor apparatus may be the direct or indirect results of wounds received in battle. The great majority depend on direct or indirect injuries of the muscles, or of their nerves, in the orbit, or at the base of the skull, by the wounding bullet or by splinters of bone. In many cases the cause of a permanent limitation of motion is a cicatricial adhesion of the eyeball to the wall of the orbit after a wound of the adnexæ. Occasionally an excess of movement in a certain direction may be produced by a laceration of the fascial ligaments. Enophthalmos and movements of retraction of the globe are not uncommon in consequence of demolition of the margins and walls of the orbit. Operative efforts to do

away with diplopia are to be considered only when the condition is one of true paresis, not due to mechanical impediments, such as cicatricial adhesions, and laceration of muscles. Of diagnostic interest are the cases in which the onset of a total ophthalmoplegia, optic atrophy, and anæsthesia of the cornea and conjunctiva located the lesion at the apex of the orbit, as is also a case in which the bullet passed sagittally through the right hemisphere and caused a complete hemiplegia of the left side, a high degree of concentric contraction of the field, a typical convergence paresis, and an isolated paresis of the left rectus superior, indicating a lesion of the ocular sympathetic fibers. In another case a shot which grazed, but did not penetrate, the right side of the head induced a paresis of the exterior branches of the right oculomotor nerve with hemiparesis and hemianæsthesia of the left side, which indicated a hemorrhage in the right pedunculus. Of the anomalies in the oculomotor apparatus not caused by wounds, those cases were of special interest in which great diminution of the power of fusion and diplopia had resulted from extraordinary straining and psychic changes. A simple heterophoria of low degree, previously latent, had now become manifest.

POLLACK (36, **Latent nystagmus**) demonstrated two cases of latent nystagmus, an affection hitherto little noticed, which is not to be classified with the other well-known forms. It appears only when one or the other eye is covered, so that binocular vision is prevented, and then it always affects both eyes. The visual power of these patients is always reduced and usually there is a marked difference between the monocular and the binocular, the latter of which is the better. Marked errors of refraction are present, in most cases associated with astigmatism. The difference between the monocular and the binocular vision, and the difficulty in fitting glasses, easily give rise to the suspicion of simulation. Such a suspicion was created in one of the two cases, a junior officer, who was at first classed by the examining surgeon as a malingerer, because the latent nystagmus had been overlooked. This is a new warning to be very careful in the diagnosis of malingering, especially in time of war.

WEHRLI (38, **Latent nystagmus**) reports six similar cases and comments on the ætiology. In all six imbalance of the

ocular muscles could be demonstrated, varying from slight insufficiency to complete paralysis of a muscle, in these cases the abducens. This lowered efficiency of a muscle Wehrli considers the principal factor in the production of latent nystagmus. The covered eye exhibits first a dissociated movement in the way of the latent strabismus present, while the uncovered one is abandoned as a single eye to the mercy of its own musculature. The impaired externus causes the eye not to hold the object of fixation, but to behave in the same way as overtired muscles after a prolonged extreme lateral turning of the eyes in the perfectly sound. Consequently the eye twitches outwards and is accompanied passively by the covered eye. In this way, he thinks, is best explained the difference in strength, frequency, and amplitude of the nystagmus, when the right or the left eye is covered, which often is quite marked, as well as the occurrence of the nystagmus when the focus of the eyes is changed from near to distance. The principal causes of the impairment of the muscles are thought to be heredity, and serious nutritive disturbances in early childhood, which may lead to injuries to the nerve cells and fibers. It is interesting that in two of the cases a position of rest could be secured by a certain position of the head, by which monolateral fixation gave good results in shooting. The eye was brought into a position of convergence in which the externi became inactive.

A patient of URBANTSCHITSCH (37, **A case of reflex nystagmus**) who suffered from cholesteatoma of the middle ear had a nystagmus which was a symptom of a fistula of the horizontal semicircular canal. Some days after the operation vertigo and nausea attacked the patient while he was lying on his right side. While in this position pressure upon a place near the posterior margin of the mastoid process induced a reflex rotatory nystagmus with vertigo. These symptoms lasted about five seconds and could be recalled after from a quarter to a half of an hour. The strength of the nystagmus varied on different days. The phenomenon could not be excited when the place in question had been anæsthetized with chlorethyl until the effect of the anæsthesia had passed off. He has observed a similar case in a woman with healthy ears.

A soldier who had collapsed psychically under the stress of battle was brought to LOEHLEIN (35, **Psychogenous paresis**

simulating a bilateral paresis of the extrinsic muscles). He suffered from headache, dizziness, and insomnia, was impassive and timorous, and had twitchings of the muscles of the face, but understood what he was about. Aside from the immobility the eyes were normal. It was easily shown that there was no true paresis of the ocular muscles by directing the patient to fix on a finger held in front of him and then rotating the head unexpectedly to the side, when the eyes turned automatically to the side. Gradually, but very slowly, a considerable improvement in the voluntary movements of the eyes took place.

X.—LIDS.

39. DISTLER and NEUNHOEFFER. **Wounds of the eye.** *Deutsche med. Wochenschrift*, 1916, No. 16, p. 494.

40. KUHNT. **Plastic operations for wounds of the eye.** *Ophthalmische Gesellschaft in Heidelberg*, July 31 and August 1, 1916.

An interesting case among those reported by DISTLER (39, **Wounds of the eye**) is one in which the cornea was wounded by a piece of stone and two eyelashes were transplanted into the anterior chamber, where they remained visible after healing. One rested on the lower margin of the pupil, the other lay on the inner lower surface of the iris near the angle of the chamber. NEUNHOEFFER describes an extensive plastic operation to replace an entire loss of the lower lid with a great part of the jaw caused by the explosion of a bomb. To form the lid a piece of skin 2 to 3*mm* below the junction of the skin and conjunctiva was cut through, the upper portion lifted up, a piece of cartilage taken from the cartilage of the ear was implanted in the defect, and covered by a flap taken from the forehead. The cartilage gave the lower lid a certain amount of firmness so that a good support for a prothesis was obtained.

KUHNT (40, **Plastic operations**) describes tersely operative measures to relieve cicatricial ectropion, colobomata, adhesions of the lid to the eye or orbit, and to replace the entire thickness of the lids. In cicatricial ectropion the skin incision should be placed if possible 1*cm* from the margin of the lid, the skin dissected back in the form of a flap, the scar thoroughly removed, and the wound then covered by a pedicled flap from the temple if it is in the lower lid, with non-pedicled

grafts if it is in the upper. Pedicled flaps are to be firmly sutured to the subjacent tissues in their middle portions in order to avoid subsequent swelling. Special directions are given for the fixation of the apex of the flap in the inner canthus. Direct union suffices for a coloboma when it is tarsal and not more than *1cm* broad, but when the entire thickness of the lid is involved the anterior portion of the lid and the tarsoörbital fascia needs to be separated from the margin of the orbit and subsequently sutured in stages with a considerable displacement of the entire temporal side of the lid towards the nose. Adhesions to the bones necessitate thorough removal of the scar, section of the anterior part of the lid and of the fascia parallel to and about *2cm* distant from the margin, shortening of the margin of the lid, transplantation of fat into the former site of the scar, and lifting of the lid for suturing. For restoration of the lids in their entire thickness he recommends for the lower lid, in addition to Frick's method, the use of double-pedicled flaps formed from the remains of the lid and the skin of the upper part of the cheek, and for the upper lid the transplantation of the lower, procedures which he describes. To relieve a symblepharon he covers the bulbar surface of the wound with a bridge flap, slides the conjunctiva over it, or uses flaps of conjunctiva from the other eye, or from the mucous membrane of the lips. To cover the inner surface of the lids he employs a pedicled flap from the upper part of the cheek, or grafts of mucous membrane or conjunctiva, which, on the upper lid, are fastened to the radiating fibres of the fascia of the superior muscle. When the eye, is absent he prefers May's operation, but uses those of Czermak and Grunert also. When a canthus is deeply sunken because of a scar, the substance of the lid is separated from the anterior crest and from the margin of the orbit, the periosteum dissected back 2 or *3cm*, the contents of the orbit thus made movable are brought forward and secured in position by deep sutures. Finally Kuhnt gives some hints in regard to the closure of large openings between the orbit and the nose, for the repair of defects in the orbital margin, and for refilling orbits traumatically deprived of their contents.

K.

(*To be continued.*)

BOOK REVIEWS.

I.—**The Ophthalmic Year Book,** Vol. XIII. Edited by Dr. EDWARD JACKSON and many collaborators. 499 pages. Herrick Book and Stationery Co., Denver, Colo., 1917. Price, $10.00.

The Year Book, bringing a review of the ophthalmic literature for 1916, is as always a welcome arrival. It is published as in some years past with assistance of the Knapp Testimonial Fund of the Section on Ophthalmology of the A. M. A. Notwithstanding the curtailment of European literature the volume is of the usual size. Drs. M. J. Feingold and Dr. Uribe-Troncoso have been added to the list of collaborators. It is intimated in the preface that the present volume probably completes a series as the Year Book will be included in the union of several of the American publications which is now under way. It is to be hoped, whatever way these reviews will appear in future, that they can be collected and brought out in the single volume form which has so well answered the purposes of the reading ophthalmologist.

A. K.

II.—**Diseases of the Eye.** BY Dr. GEO. E. DESCHWEINITZ. Eighth Edition. 754 pages. W. B. Saunders Co., Phila., 1916. Price, $6.00 net.

The new edition of this well-known and justly popular textbook continues to show the mark of a painstaking author, characteristic of previous editions, namely that it is thoroughly up to date and this volume contains all of the important observations and operative procedures which have been published in the last three years. Among these are: anaphylactic keratitis, ocular symptoms of pituitary lesions, preliminary capsulation, iridotasis, extraction of lens in capsule after subluxation with capsule forceps and tenotomy of the inferior

oblique. The chapter on iritis has been rewritten with due regard to the autotoxic nature of this disease. A description of sclerocorneal trephining is given by Col. Elliot himself, and Dr. Sweet has revised the description of localizing intraocular foreign bodies. The thorough revision with important additions will insure the high standard which this excellent text-book has always maintained.

A. K.

III.—**Text-Book of Ophthalmology.** By Professor E. Fuchs, Vienna. Translated and edited by Dr. A. Duane, New York. Fifth Edition; pages, 1067, illustrated. J. B. Lippincott Co., Phila., 1917. Price, $7 net.

The New American edition of Fuchs's Ophthalmology is an authorized translation from the twelfth German edition with numerous additions supplied both by the author and the translator. The appearance of a new edition of "Fuchs" is always an ophthalmological event; this particular one is especially so as it is in many ways a new work. The remarks in fine print which were formerly placed at the end of each chapter have been split up and introduced in the text where they belong. Parts of the chapter on motility have been entirely rewritten by Dr. Duane; this refers particularly to the section on the ocular paralyses which is now a masterly presentation of this important and difficult subject. Other additions have been made to the chapters on glaucoma, on diseases of the retina, on refraction, accommodation, and operations. Fuchs's text-book is too well known to require further description or comment except that by the rearrangement of the text and the many valuable additions of the able American collaborator the book is more than ever a "model of its kind." Many of the old illustrations, however, have suffered; it is a pity that in this new edition the old plates were not replaced.

A. K.

IV.—**Cataract.** By Dr. W. A. Fisher, Chicago. Pages 119; illustrated. Published by Chicago Eye, Ear, Nose, and Throat College, 1917. Price, $1.50.

This short volume treats of the senile, traumatic, and congenital forms of cataract. In reviewing the literature on the

modern methods of cataract extraction the author finds that a most concise discussion of the various operative procedures is given by J. W. Wright of Columbus, Ohio, in his text-book on ophthalmology. Dr. Wright in 1884 described a practical method of cataract extraction in the capsule which he continued to perform for thirty years. The part "on the extraction of cataract" is quoted from Wright's book, and a description with criticism of the Smith-Indian operation is taken from the more popular modern text-books. The rest of the book contains previously published papers on cataract by the author, and, as they have not suffered from lack of publicity, need no further comment.

A. K.

V.—**Diseases of the Eye.** By Dr. C. H. MAY, New York. Ninth Edition. 440 pages and 377 illustrations. Publishers: W. WOOD & Co., New York, 1917. Price, $2.50 net.

Dr. May's well-known little manual again appears in a new edition. It has been revised and brought up to date without an increase in size, which will surely insure its continued popularity. A. K.

VI.—**Helmholtz's Description of an Ophthalmoscope.** By Dr. T. H. SHASTID, Superior, Wis. 33 pages. The Cleveland Press, Chicago, 1916.

Dr. Shastid has rendered a great service to ophthalmology by translating into English and bringing to the attention of the younger era of ophthalmologists the description of the epoch-making discovery of the ophthalmoscope. The little book contains a literal translation of Helmholtz's original article "Beschreibung eines Augenspiegels" as it appeared in Berlin in 1851, and a reproduction of the original illustration of the first ophthalmoscope. It is of interest not only as a description of a wonderful instrument but the way in which this description is worded is characteristic of a master mind. The translation is dedicated to Dr. Casey A. Wood.

A. K.

VII.—**The Fundus Oculi of Birds.** By Dr. CASEY A. WOOD, Chicago. 180 pages, with 45 drawings in text and 61 colored paintings. Published by The Lakeside Press, Chicago, 1917.

This is an examination of the fundus oculi in birds, a study to which, as the author states in the preface, but little attention has thus far been paid. The anatomy and physiology of the eye grounds of birds are first described, and are followed by chapters on the use of the ophthalmoscope designed for non-ophthalmologists, with a description of the fundus picture and of the macroscopic appearance in prepared specimens. The various orders of birds are then taken up in turn and a classification is attempted from the eye-ground changes. This part is illustrated by 61 colored paintings by the well-known English artist, A. W. Head. These remarkable pictures require especial mention not only for the beauty of their complex coloring but also for their successful reproduction. Dr. Wood's contribution to comparative ophthalmoscopy is a monumental and classical piece of work.

A. K.

VIII.—The Nervo-Muscular Mechanism of the Eyes, and Routine in Eye Work. By G. C. SAVAGE, M.D., author of *New Truths in Ophthalmology, Ophthalmic Myology*, etc. Published by the Author. Nashville, Tenn. Price, $1.00.

This little book of seventy pages is composed of two papers; the first read by the author before the Southern Medical Association in 1915 and the second before the Tennessee State Medical Association in 1916.

The paper on the nervo-muscular mechanism of the eyes treats with some detail the nuclear and cortical centers and their connection with associated and dissociated action of the eyes.

This is still a field for original research and the author deserves much credit for the original work he has done.

The paper on Routine in Eye Work gives the author's office routine, paying particular attention to his routine muscle tests and the use of the De Zeng monocular phorometer and cyclophorometer. Opinions differ widely on the value of these instruments and as to the reliability of the findings.

The book is most interesting to either the proponent or opponent of the theories.

J. W. WHITE.

CORRESPONDENCE.

August 18, 1917.

EDITOR ARCHIVES OF OPHTHALMOLOGY:

Mr. Zorab has called my attention to a regrettable error in the last English edition of Fuchs's *Ophthalmology*. On page 986 are the words: "This operation, originally performed by Zorab and revived by Wood, is designed mainly for employment in absolute glaucoma."

This gives the impression that the operation of seton drainage or aqueoplasty, devised by Mr. Zorab, had fallen into desuetude. This is not the case. Mr. Zorab has performed it systematically ever since he first suggested it, and that too, not only for absolute glaucoma, but for glaucoma in all stages.

I shall be glad if, in justice to Mr. Zorab, you will make this correction.

Sincerely yours,

ALEXANDER DUANE.

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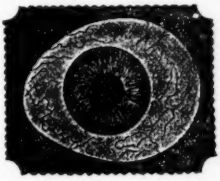

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